



# Chesapeake Bay

National Estuarine Research Reserve

# Maryland

**FINAL MANAGEMENT PLAN: 2008-2012**

July 2008



*Mission: Improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.*

*“Sound Science...Finding Solutions...Wise Decisions”*



Photo by Elaine Friebele: Great blue heron tracks in snow at Jug Bay Wetlands Sanctuary, February 7, 2007.

This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and the provisions of the (Insert State) Coastal Management Program. July 2008.

Prepared by:  
Maryland Department of Natural Resources  
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Prepared for:  
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Estuarine Reserves Division



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## Table of Contents

<b>Executive Summary</b> .....	1
<b>1 Introduction</b> .....	11
1.1 Purpose and Scope of Management Plan .....	11
1.2 National Estuarine Research Reserve System .....	11
1.3 Chesapeake Bay Context .....	16
1.4 Key Management Issues .....	16
<b>2 Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD) Description</b> .....	19
2.1 Chesapeake Bay Biogeography and Eco-Region.....	19
2.2 Description of the Reserve Components .....	20
2.3 CBNERR-MD Major Accomplishments (1990-2008) .....	28
<b>3 CBNERR-MD Mission, Goals and Objectives</b> .....	33
3.1 CBNERR-MD and Maryland Department of Natural Resources Vision and Mission .....	33
3.2 CBNERR-MD Goals .....	33
3.3 CBNERR-MD Management Issues .....	33
3.4 CBNERR-MD Goals and Objectives.....	34
<b>4 Administration</b> .....	37
4.1 Introduction.....	37
4.2 Chesapeake Bay Context: Administration.....	38
4.3 CBNERR-MD Management Issues .....	38
4.4 CBNERR-MD Administration Goals, Objectives, and Strategies.....	40
4.5 Administrative Approach: Management Structure of CBNERR-MD .....	42
4.6 Key Partners .....	51
4.7 Future Directions .....	51
<b>5 Research and Monitoring</b> .....	55
5.1 Introduction.....	55
5.2 Chesapeake Bay Context: Research and Monitoring.....	61
5.3 CBNERR-MD Management Issues .....	62
5.4 CBNERR-MD Research and Monitoring Goals, Objectives, and Strategies.....	63
5.5 Research and Monitoring Efforts at CBNERR-MD .....	69
5.6 Key Partners .....	71
5.7 Future Directions .....	72
<b>6 Education and Interpretation</b> .....	75
6.1 Introduction .....	75
6.2 Chesapeake Bay Context: Education .....	77
6.3 CBNERR-MD Management Issues .....	78
6.4 CBNERR-MD Education Goals, Objectives, and Strategies .....	79
6.5 Education Approach and Efforts at CBNERR-MD .....	83
6.6 Key Partners .....	87
6.7 Future Directions .....	88

<b>7 Coastal Training Program</b>	91
7.1 Introduction	91
7.2 Chesapeake Bay Context: Coastal Training and Outreach	91
7.3 CBNERR-MD Management Issues	92
7.4 CBNERR-MD Coastal Training Program Goals, Objectives, and Strategies	93
7.5 Coastal Training Program Efforts at CBNERR-MD	95
7.6 Key Partners	96
7.7 Future Directions	96
<b>8 Stewardship/Resource Protection</b>	97
8.1 Introduction	97
8.2 Chesapeake Bay Context: Stewardship	97
8.3 CBNERR-MD Management Issues	98
8.4 CBNERR-MD Stewardship Goals, Objectives, and Strategies	99
8.5 Stewardship Approach and Efforts at CBNERR-MD	102
8.6 Key Partners	118
8.7 Future Directions	119
<b>9 Public Access and Visitor Use</b>	121
9.1 Introduction	121
9.2 Chesapeake Bay Context: Public Access	121
9.3 CBNERR-MD Management Issues	121
9.4 CBNERR-MD Public Access Goals, Objectives, and Strategies	122
9.5 Public Access at CBNERR-MD	123
9.6 Key Partners	126
9.7 Future Directions	127
<b>10 Boundary Expansion and Land Acquisition</b>	129
10.1 Introduction	129
10.2 Chesapeake Bay Context: Land Acquisition	129
10.3 CBNERR-MD Management Issues	129
10.4 CBNERR-MD Land Acquisition Goals, Objectives, and Strategies	130
10.5 Land Acquisition Approach and Boundary Expansions at CBNERR-MD	131
10.6 Key Partners	142
10.7 Future Directions	142
<b>11 Facilities and Equipment</b>	151
11.1 Introduction	151
11.2 Chesapeake Bay Context	151
11.3 CBNERR-MD Management Issues	151
11.4 CBNERR-MD Facility and Equipment Goals, Objectives, and Strategies	152
11.5 Facilities, Construction, and Equipment Needs and Plans at CBNERR-MD	153
11.6 Key Partners	153
11.7 Future Directions	154

## **Appendices**

- Appendix A – CBNERR-MD Accomplishments 1990-2008
- Appendix B – Federal Regulations
- Appendix C – Memorandum of Understanding between Maryland Department of Natural Resources and the National Oceanic and Atmospheric Administration
- Appendix D – Otter Point Creek Component Memoranda of Understanding and Conservation Easements
  - D1. MOU (original)
  - D2. MOU Addendum
  - D3. Conservation Easement between Izaak Walton League of America and Maryland Environmental Trust
- Appendix E – Jug Bay Component Memoranda of Understanding – Patuxent River Park, Maryland-National Capital Park and Planning Commission
  - E1. MOU (original)
  - E2. MOU Addendum
- Appendix F – Jug Bay Component Memoranda of Understanding, Covenants and Conservation Easements – JBWS
  - F1. MOU (original)
  - F2. MOU Addendum
  - F3. JBWS Covenants
  - F4. Glendening Preserve Conservation Easement Between Anne Arundel County and the State of Maryland Department of Natural Resources
- Appendix G – Monie Bay Component Memorandum of Understanding
- Appendix H – Public Meetings and Comments
- Appendix I – Facilities Table
- Appendix J – Table of Research Activities Identified for Otter Point Creek, Jug Bay, and Monie Bay Components of CBNERR-MD
- Appendix K – Table of NERRS Goals and CBNERR-MD Goals and Objectives
- Appendix M – Complete Set of CBNERR-MD Full-Sized Maps

## **List of Maps**

Figure 1. Chesapeake Bay National Estuarine Research Reserve in Maryland Components (1990 boundaries) .....	1
Figure 2. National Estuarine Research Reserve System .....	14
Figure 3. Chesapeake Bay National Estuarine Research Reserve in Maryland Components (2008 boundaries) .....	21
Figure 4. Otter Point Creek, Core and Buffer Areas - Original.....	23
Figure 5. Jug Bay Core and Buffer Areas - Original .....	25
Figure 6. Monie Bay – Core and Buffer Areas .....	27
Figure 7. Otter Point Creek Expansion, Core and Buffer Areas .....	135
Figure 8. Jug Bay Expansion, Core and Buffer Areas .....	139
Figure 9. Monie Bay – Core and Buffer Areas .....	141
Figure 10. Otter Point Creek - Targeted Protection Areas and Green Infrastructure ....	145
Figure 11. Jug Bay - Targeted Protection Areas and Green Infrastructure.....	147
Figure 12. Monie Bay - Targeted Protection Areas and Green Infrastructure .....	149

## **List of Tables**

Table 1. CBNERR-MD Area Summary – Reserve Acres.....	21
Table 2. Management Structure of the Reserve.....	37
Table 3. Summary of CICEET-Funded Projects in Maryland .....	60
Table 4. Examples of Key Coastal Training Providers in Maryland.....	90
Table 5. Guidelines for Protecting Forest Interior Habitat.....	103
Table 6. 2004 Strategic Plan Summary – Jug Bay Wetlands Sanctuary.....	106
Table 7. CBNERR-MD Land Acquisition Priorities to Enhance Access/Utility .....	132
Table 8. CBNERR-MD Land Acquisition Priorities for Natural Resource Protection .	132
Table 9. Otter Point Creek Component Boundary Expansion.....	133
Table 10. Jug Bay Component Boundary Expansion .....	133
Table 11. Monie Bay Component Boundary Expansion.....	133
Table 12. CBNERR-MD Priorities for Construction and Site Improvements .....	154
Table 13. CBNERR-MD Facilities Construction Plan 2008-2012.....	155
Table 14. CBNERR-MD Equipment Plan 2008-2012.....	156

## **List of Acronyms**

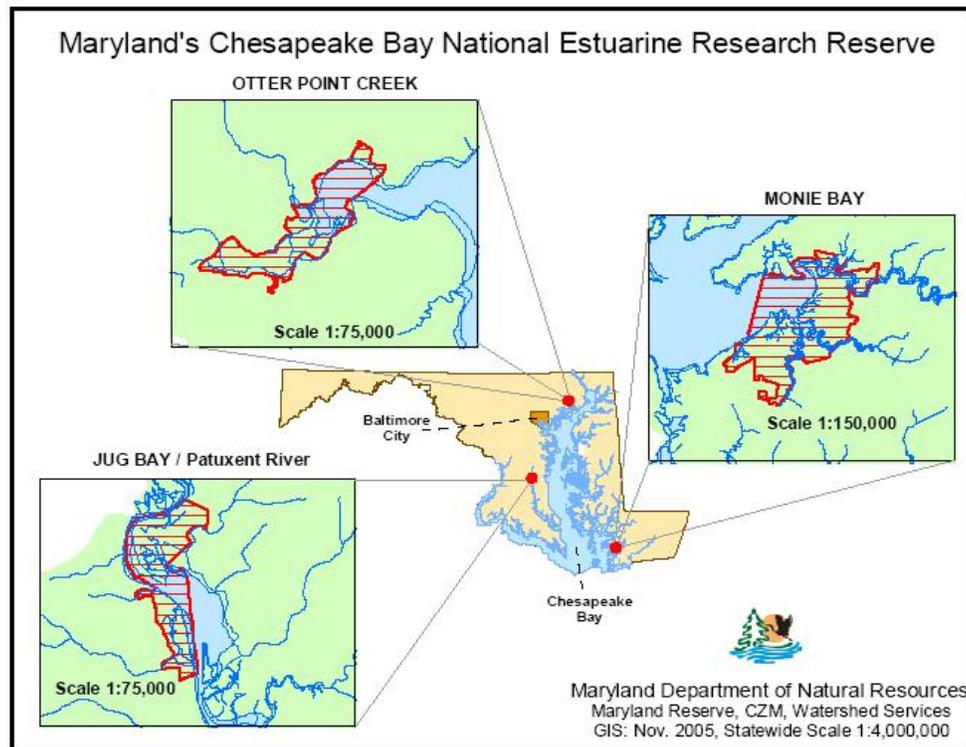
ACLEC	Anita C. Leight Estuary Center (part of Otter Point Creek component of CBNERR-MD)
BRAC	Base Realignment and Closure
CBF	Chesapeake Bay Foundation
CBIG	Chesapeake Bay Implementation Grant
CBNERR-MD	Chesapeake Bay National Estuarine Research Reserve in Maryland
CBNERR-VA	Chesapeake Bay National Estuarine Research Reserve in Virginia
CCWS	Chesapeake and Coastal Watershed Services (unit in DNR in which CBNERR-MD resides)
CDMO	Centralized Data Management Office (NERRS)
CELCP	Coastal and Estuarine Land Conservation Program (NOAA)
CFR	Code of Federal Regulations
CICEET	Cooperative Institute for Coastal Estuarine Environment Technology (NOAA)
COMAR	Code of Maryland Regulations
CO-OPS	Center for Operational Oceanographic Products and Services
CTP	Coastal Training Program
CWRAC	Coastal and Watershed Resources Advisory Committee
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DIWMA	Deal Island Wildlife Management Area (DNR land management unit that contains Monie Bay, which is a component of CBNERR-MD)
DNR	Department of Natural Resources (Maryland agency with responsibility for Coastal Zone Management, CBNERR-MD, Maryland Chesapeake Bay programs, fish and wildlife management, land acquisition and park management, Natural Resources Police)
DOQQ	Digital Orthophotography Quarter Quadrangles
EAV	Emergent Aquatic Vegetation
EC	Education Coordinator
ECSC	Environmental Cooperative Science Center, Morgan State University
ED	Environmental Design
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
ERD	Estuarine Reserves Division (at NOAA)
FIDS	Forest Interior Dwelling Species
FOJB	Friends of Jug Bay
GIA	Green Infrastructure Assessment
GIS	Geographic Information Systems
GRF	Graduate Research Fellowship
HAB	harmful algal blooms
IBA	Important Bird Area
IOOS	Integrated Ocean Observing System
IWLA	Izaak Walton League of America (Harford County Chapter is owner of Melvin G. Bosely Conservancy, which is part of Otter Point Creek component of CBNERR-MD)
JBNA	Jug Bay Natural Area (part of Jug Bay component of CBNERR-MD within Patuxent River Park operated by MNCPPC, Prince George's County, Maryland)
JBWS	Jug Bay Wetlands Sanctuary (part of Jug Bay component of CBNERR-MD operated by Anne Arundel County Recreation and Parks)
KEEP	K-12 Estuarine Education Program

LID	Low-Impact Development
LIDAR	Light Detection and Ranging (method to measure high-resolution elevation)
LLT	Local Land Trust
MACOORA	Mid-Atlantic Coastal and Ocean Regional Association
MD or Md	Maryland
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MET	Maryland Environmental Trust (a State semi-public agency that works with private property owners and local land trusts to obtain conservation easements)
MNCPPC	Maryland-National Capital Park and Planning Commission (a bi-county agency with planning, zoning, land acquisition and park management authority in Montgomery County and Prince George's County, Maryland)
MOU	Memorandum of Understanding
MSDE	Maryland State Department of Education
NAIB	National Aquarium in Baltimore, Maryland
NEMO	Network for Education of Municipal Officials
NEPA	National Environmental Policy Act
NERRS	National Estuarine Research Reserve System
NOAA	National Ocean and Atmospheric Administration
NWLON	National Water Level Observation Network
OCRM	Office of Ocean and Coastal Resource Management
OPC	Otter Point Creek (component of CBNERR-MD)
OPCA	Otter Point Creek Alliance (volunteer group working with and supporting the Otter Point Creek component of CBNERR-MD)
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PRP	Patuxent River Park
RC	Research Coordinator
RAS	Resource Assessment Service (at DNR)
SAC	Science Advisory Committee
SAV	submerged aquatic vegetation (bay grasses)
SC	Stewardship Coordinator
SET	Surface Elevation Table
SERC	Smithsonian Environmental Research Center
SWMP	System-wide Monitoring Program
TEA	Tidewater Ecosystem Assessment (part of RAS at DNR)
UMCES	University of Maryland Center for Environmental Science
UMD	University of Maryland
UNH	University of New Hampshire
USFWS	US Fish and Wildlife Service
VECOS	Virginia Estuarine and Coastal Observing System
VIMS	Virginia Institute of Marine Science
VOC	volatile organic carbon
VSC	voluntary State curriculum
WHS	Wildlife and Heritage Service (unit in DNR, operates Deal Island Wildlife Management Area and CBNERR-MD Monie Bay component in Somerset County)
WMA	Wildlife Management Area
WRAS	Watershed Restoration Action Strategy

WWTP Wastewater Treatment Plant

## Executive Summary

Maryland's Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD or "the Reserve") was established by the Maryland Department of Natural Resources (DNR) in 1985 with Monie Bay in Somerset County being the sole component. In 1990 Otter Point Creek (in Harford County) and Jug Bay (in Prince George's and Anne Arundel Counties) were added to the Reserve. Together, these three Reserve components reflect the diversity of estuarine habitats found within the Maryland portion of the Chesapeake Bay (Figure 1). Each component is managed and protected in perpetuity to provide an outstanding environment for conducting research and monitoring, education, and coastal management training programs.



**Figure 1. CBNERR-MD Components (1990 boundaries)**

***Federal Requirement for Management Plan*** Federal regulations require all National Estuarine Research Reserves to have a NOAA-approved management plan, which is updated regularly. This management plan is consistent with National Oceanic and Atmospheric Administration (NOAA) regulations (15 CFR Part 921) in consideration of information derived from research and public input. It is consistent with the Congressional intent of Section 315 of the Coastal Zone Management Act of 1972 (as amended), the commitments of the 1987 Chesapeake Bay Agreement and its subsequent amendments, and the provisions of the Maryland Coastal Zone Management Program. It is also consistent with the goals, objectives, and policies of the National Estuarine Research Reserve System (NERRS).

***Purpose and Scope of Management Plan*** The purpose of this management plan is to inform interested parties about CBNERR-MD and to provide the forward thinking framework that will help to guide the Reserve's activities. The scope of the management plan is to ensure that the Reserve maintains its components as representative natural areas for long-term research, monitoring, education, and coastal training in accordance with a central vision, mission, goals and objectives.

***Reserve Mission and Goals: Making Wise Decisions and Finding Solutions Using Sound Science***

***Reserve Mission.*** The mission of CBNERR-MD is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders. The Reserve will help to achieve the Maryland Department of Natural Resources mission "to preserve, protect, enhance and restore Maryland's natural resources for the wise use and enjoyment of all citizens." This management plan describes how the Reserve preserves, protects, enhances and restores approximately 5,000 acres of uplands and wetlands; conducts research and monitoring, education, and coastal training programs; and provides public access to these lands.

***Reserve Goals.***

- Strengthen the protection and management of the Reserve to advance estuarine conservation, research and education.
- Increase the use of science and Reserve sites to address management issues.
- Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.

***CBNERR-MD Management Issues.*** As the Nation's largest estuary and a region experiencing substantial population growth, increasing development pressures, and land use changes, as well as subsidence and sea level rise, the Chesapeake Bay region is confronted with numerous management issues. The Reserve's programs are primarily focused on five management issues.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows. These losses and alterations affect both: 1) hydrologic and pollutant inputs, and 2) living resource food web dynamics and community structure.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure. These issues have both ecosystem and socio-economic implications. Delaware and Maryland are the third and fourth most vulnerable states to sea level rise after Louisiana and Florida, and the Monie Bay component is located in one of the most vulnerable counties in Maryland.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates). Reserve programs will address issues related to reduced population numbers and species diversity. In addition to the stressors listed above, bacterial contamination, toxic contamination, and invasive species affect these populations and communities.
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities. Losses and changes to these communities will be investigated and addressed. In addition to the stressors listed above invasive species can adversely affect these plant communities and reduce habitat value.
- Healthy water quality/habitat. Key factors that degrade water quality include excessive nutrients and sediments. For example, these factors can cause low dissolved oxygen, less desirable phytoplankton and zooplankton assemblages, and harmful algal blooms.

The Reserve will achieve its mission and goals through:

- *Administration*: Seeking resources including funding to enhance all Reserve program sectors, cultivating new and foster existing relationships with partners, and supporting staff professional development.
- *Research and Monitoring*: Conducting, coordinating, and translating relevant research and monitoring information to improve decision-making.
- *Education*: Building estuarine and environmental literacy through programs with teachers, students, and communities that will connect them to the Bay and move them to take action toward its protection and restoration.
- *Coastal Training Program (CTP)*: Facilitating informed and improved decision-making by making estuarine research relevant, meaningful, and accessible to managers and stakeholders. The initial focus is to develop Coastal Trainings that help elected and appointed officials make wise decisions and find solutions using sound estuarine science.
- *Stewardship*: Protecting, managing and restoring three ecologically-valuable estuarine sites and providing stewardship opportunities for Marylanders.

Administration and each of the sectors (Research, Education, Coastal Training, and Stewardship) is described in more detail below.

### ***Administration/Management Structure of the Reserve***

CBNERR-MD is managed through a cooperative approach led by the Maryland Department of Natural Resources (DNR) and involving local partners—Harford County Parks and Recreation, Harford County Chapter of the Izaak Walton League of America, Maryland-National Capital Park and Planning Commission (MNCPPC), and Anne Arundel County Recreation and Parks. One of 27 National Estuarine Research Reserves around the nation, CBNERR-MD is funded 70 percent by NOAA funding and 30 percent by State and local match.

## ***Research and Monitoring***

A key goal of the National Estuarine Research Reserve System (NERRS) is to “deliver relevant and timely information to support informed decision-making and increase public understanding of the importance of protecting estuarine and coastal habitats for future generations.” CBNERR-MD supports this goal.

Monitoring efforts investigate long-term trends and short-term variability. In addition to continuous monitoring of water quality and weather information, significant information is collected at the Reserve components on ecologically and economically important animals and their habitats. Important habitats, including bay grasses (submerged aquatic vegetation-SAV) and marsh plants, are measured and how they are changing over time is recorded. CBNERR-MD monitoring efforts tie in with broader monitoring efforts at the State of Maryland level (e.g., Eyes on the Bay) and the national level (e.g., the Integrated Ocean Observing System).

Cutting edge research relevant to protecting and restoring the Bay is conducted at all three components. Examples include exploring methods for reducing excess nutrient pollution to the Bay from agricultural waste, and investigating elevation changes over time in response to subsidence and sea level rise.

## ***Education***

The CBNERR-MD is an important vehicle for increasing understanding and awareness of the Chesapeake Bay as a vital and productive albeit challenged estuarine system. The education, training and outreach programs that have been developed, implemented and/or supported by the Reserve have helped various communities take action based on that increased understanding and awareness. Members of various educational, decision maker and public communities have participated in Reserve educational programming and learned about such topics as bay grasses and efforts to restore them, the impact of septic systems on the habitat and water quality of the Bay, and other topics relevant to the Reserve. All educational opportunities strive to integrate research with educational and outreach programming.

Future directions include increasing effective education to underserved populations; increasing the number of Marylanders who change personal behavior and serve as leaders to promote sound and informed decision-making throughout the community; and continuing to build estuarine and environmental literacy through programs with teachers, students, and communities that will connect them to the Bay and move them to take action toward its protection and restoration.

The Reserve is well positioned to facilitate educational opportunities that may ultimately lead to behavior changes and actions that result in improved estuarine conditions. The Reserve could help to establish a pathway for individuals to become informed about the estuary, involved in its restoration, and ultimately provide leadership in the effort to achieve a healthy estuarine system. This pathway will promote the strengths of the Reserve and allow access to its resources for the long-term engagement of individuals participating in this pathway. The pathway may begin with students in a classroom

studying the estuary, then move to individuals participating in field experiences, and finally move to individuals participating in research and stewardship internships and opportunities. The role of the Reserve will be to promote and facilitate participation in this pathway as the students and other individuals move through it by providing—in partnership with others—educational, stewardship, internship/research, and leadership opportunities.

### ***Coastal Training Program***

The Coastal Training Program (CTP) holds trainings that provide science-based information, tools and techniques to coastal decision-makers. Through this program, decision-makers have the opportunity to gain valuable information and build their working knowledge of critical coastal issues to ensure that sound decisions are made at the local, State and regional level.

Target audiences vary throughout the National Estuarine Research Reserve System (NERRS), and can include local land use planners and elected officials, regulators, community groups, land developers, watermen, non-profit organizations, applied scientific groups and business associations, among others. CBNERR-MD's Coastal Training Program will initially target local elected and appointed officials and their staff. The coastal counties near the Reserve components will be targeted first. The primary focus will be helping these decision-makers to protect and manage coastal resources by effectively planning for and responding to 1) population growth and development and 2) climate change and sea level rise.

The Coastal Training Program will bring together professionals from diverse backgrounds to develop networks and collaborative partnerships to solve complex and often contentious coastal issues. Programs can be delivered in a variety of formats ranging from seminars and lectures, to hands on technical training, to field-based learning opportunities.

Future directions include expanding the target audience to include more decision-makers and expanding the geographic scope of the Coastal Training Program to include more coastal counties.

### ***Stewardship-Resource Protection & Management***

The health, productivity, and integrity of the three Reserve components and their resources must be protected and, where necessary, restored in order to provide a stable environment for research, monitoring, and education programs. These programs, in turn, are used to address coastal management issues. Protection is achieved through Memoranda of Understanding (MOU) and conservation easements with the partners. Management of the resources is handled cooperatively with the partners. The Reserve also provides stewardship opportunities for Maryland's urban and rural residents through a wide variety of volunteer programs.

Future directions include: Protecting components through easements or outright acquisitions; enforcing MOUs and conservation easements; developing and/or updating

site profiles and site natural resource management plans, as appropriate, and; coordinating with the Coastal Training Program to help decision-makers protect and manage coastal resources by effectively planning for and responding to 1) population growth and development and 2) climate change and sea level rise.

### ***Public Access and Visitor Use***

Providing public access to the Reserve is important to build support for the Reserve and foster a connection to and sense of stewardship of the Chesapeake Bay. At the same time, controlling public access is important to protect the Reserve, particularly core areas, so that they can function as reference sites for research and education programs.

Public access for the Reserve varies at the different components and at different areas within each component. Access is provided for research, education, and coastal training programs, with limited access provided for public unprogrammed use. The Reserve staff work closely with the site partners to control access, particularly to core areas of each component. At Otter Point Creek and Jug Bay, there is good access infrastructure, and the priority looking to the future is to control and direct access (particularly at Otter Point Creek), due to high and growing human population densities and use pressure.

There is currently no suitable access to the Monie Bay component. This lack of access cripples the ability to run programs at this site. The top priority at Monie Bay will be to acquire property abutting both a road and deep water to provide suitable access for scientists, teachers, students, decision-makers, and the public to participate in CBNERR-MD programs.

### ***Land Acquisition and Boundary Expansion***

#### **Land Acquisition**

Within CBNERR-MD, there are five entities that have a capability to interact with neighboring property owners, to manage and to acquire land:

- Maryland Department of Natural Resources (multiple divisions and programs)
- Harford County Parks and Recreation Department
- Izaak Walton League of America, Harford County Chapter
- Maryland-National Capital Park and Planning Commission Department of Parks and Recreation
- Anne Arundel County Department of Recreation and Parks

Each of these entities acts independently to meet land acquisition interests within its jurisdiction and interests. In addition, they may act in partnership with one another and/or in partnership with the State and NOAA to meet the interests of the Reserve.

To achieve its mission, CBNERR-MD must protect the Reserve lands and waters in perpetuity to serve as reference areas and living laboratories for research and as classrooms for education programs. In addition, suitable facilities, infrastructure, staging

areas, and access to the resource are needed to support research, education, coastal training, and stewardship programs.

Due to the dire need at Monie Bay for suitable facilities and access needed to support programs, the top land acquisition priority over the next five year will be to acquire the necessary land for this. NERRS construction and acquisition funds, Maryland Program Open Space (POS) funds, and other funding sources will be sought for this purpose.

The second priority will be to acquire lands at all three of the Reserve components to complete ecological units and help buffer and protect the Reserve. NERRS construction and acquisition funds, NOAA Coastal and Estuarine Land Conservation Program (CELCP) funds, POS funds, and other funding sources will be sought to achieve this. The following criteria are used to identify appropriate lands for this purpose:

- Green Infrastructure Hubs and Corridors adjacent to Reserve
- Local ecological estuarine units including wetlands and an appropriate buffer of land and open water
- Tributary stream riparian/buffer areas
- Completion of a contiguous, uninterrupted, protected natural resource area that inherently lends itself to long-term site protection and management needs of the Reserve
- Adjacent or upstream areas that, if restored, are likely to enhance the long-term viability of the Reserve core area (including undeveloped areas upland of marshes that may disappear due to erosion and sea level rise to allow for marsh migration)

Maps of lands targeted by CBNERR-MD for protection are included in Chapter 10.

### **Boundary Expansion**

This management plan calls for the boundary expansion of the Reserve at two component sites—Jug Bay and Otter Point Creek—for a total increase of 1,377 land acres. Consistent with 15 CFR §921.1(b) the land incorporated through this expansion will ensure a stable environment for research through the long term protection of resources. The land contained within the expanded boundaries is composed of both core and buffer areas integral to the reserve component.

*Planned Boundary Expansion.* The boundary expansion at Otter Point Creek will include 32 acres of Harford County Park land at Leight Park into the Reserve. The boundary expansion at the Jug Bay component will include the addition of 1,345 additional land acres, including 455 acres of Patuxent River Park land owned by the Maryland-National Capital Park and Planning Commission added on the Prince George’s County side of the river (west) and 890 acres of Jug Bay Wetlands Sanctuary land owned by Anne Arundel County on the east side of the river.

Leight Park. Harford County’s Leight Park at the Otter Point Creek component was expanded in 2002 to include an adjacent 32.1-acre parcel. The parcel is largely a mid-aged forest and serves as a buffer for the core estuarine area. This new land will allow for both research and educational programming to occur in the forest.

Patuxent River Park, Jug Bay Natural Area: The boundary expansion at the Jug Bay component will include the watershed of Black Walnut Creek—455 additional acres of land that is part of the Patuxent River Park on the Prince George’s County side (west) of the river.

Jug Bay Wetlands Sanctuary: The boundary expansion at the Jug Bay component will incorporate Jug Bay Wetlands Sanctuary as it currently exists into the Reserve on the Anne Arundel side (east) of the River. This includes adding 890 acres to the component to make the total land acreage at the Sanctuary 1,062 acres. The new boundary will encompass riverfront and wetland core areas as well as upland forest and streams that flow to the Patuxent River. The additional parcels are comprised of forests, old pastures, agricultural fields, streams, vernal pools, non-tidal and tidal wetlands, streams, and sand barrens. These parcels include core wetland areas, as well as buffer areas to protect the core areas, and they will provide opportunities for research and education.

*Future Directions for Boundary Expansion.* Opportunities for further expansion of the Reserve’s boundaries exist at all of the component sites. Priority will be give to those expansions that: (1) protect or enhance access/use capabilities or (2) provide for inclusion or substantial protection of core estuarine areas. The Monie Bay component will be the initial focus of future boundary expansion efforts due to the need to establish a location from which research and educational programming will occur.

### ***Facilities and Equipment***

To achieve its mission, CBNERR-MD must conduct estuarine stewardship, research, education and coastal training programs. To implement these programs, facilities are needed such as education/visitor centers, walking trails/boardwalks, overlooks, office space, bathrooms, research facilities, staging areas, storage facilities, and water access facilities, such as piers, docks, and ramps. Exhibits and signs are needed to for education and outreach purposes. Vessels and vehicles are needed to conduct research and education programs.

Within the Reserve, there are five entities that have the capability to undertake construction projects, obtain permits and approvals, and manage construction contractors:

- Maryland Department of Natural Resources (multiple divisions and programs)
- Harford County Parks and Recreation Department
- Izaak Walton League of America, Harford County Chapter
- Maryland-National Capital Park and Planning Commission Department of Parks and Recreation
- Anne Arundel County Department of Recreation and Parks

Each of these entities acts independently to address construction needs on properties that they manage. In addition, they may act in partnership with one another and/or in partnership with NOAA to meet the interests of the Reserve.

CBNERR-MD DNR staff are housed in the Maryland Department of Natural Resources (DNR) headquarters, which is the Tawes State Office Building in Annapolis, Maryland. This is central to the three Reserve components and is approximately 30 miles from Jug Bay, 50 miles from Otter Point Creek, and 100 miles from Monie Bay. Major facilities at the components are:

- Otter Point Creek
  - Anita C. Leight Estuary Center in Harford County's Leight Park
- Jug Bay
  - Visitor Center and headquarters building in Patuxent River Park in Prince George's County operated by Maryland-National Capital Park and Planning Commission
  - McCann Wetlands Study Center in Anne Arundel County's Jug Bay Wetlands Sanctuary
  - Plummer House (office, meeting, and education space) in Anne Arundel County's Jug Bay Wetlands Sanctuary

The Reserve is situated in four counties in Maryland. In three of these counties, there are other large environmental education centers, which are associated with the county school systems:

- Harford County – Harford Glen
- Prince George's County – Schmidt Outdoor Education Center
- Anne Arundel County – Arlington Echo

Somerset County, however, does not have any private or public environmental education centers, nor is there any CBNERR-MD facility on that component. The Monie Bay socio-cultural needs assessment identified a strong need in Somerset County for a Research/Education/Cultural Visitor Center.

“Without exception, informants expressed a need for a place or places to focus the communities' and NERR-MD's education and outreach efforts. This place(s) was most frequently expressed as some sort of museum or visitor center, either situated in one place or consisting of multiple sites. Residents were also quite open to ideas about where to situate such a museum or visitor center. The main concern was to find a piece of land where it would be possible to build something, and to do that soon, since property values are rising quickly.”  
(p. 65, *Linking Estuarine Ecology and Community Heritage: A Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005)

Therefore, providing facilities for programming at Monie Bay will be CBNERR-MD's highest facilities construction priority over the next five years.



## 1. INTRODUCTION

Maryland's Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD or the Reserve) is one of 27 National Estuarine Research Reserves nationwide established as protected areas to "practice and promote coastal and estuarine stewardship through innovative research and education." The Reserve includes three components: Otter Point Creek and Jug Bay, both designated in 1990, and Monie Bay, designated in 1985. The mission of the Reserve is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

### 1.1 Purpose and Scope

This management plan informs interested parties about CBNERR-MD and provides direction for the programs, projects and activities of the Reserve. This document describes a five-year plan outlining program objectives and strategies designed to achieve the goals and mission of the Reserve.

This management plan is consistent with National Oceanic and Atmospheric Administration (NOAA) regulations (15 CFR Part 921) in consideration of information derived from research and public input. It is consistent with the Congressional intent of Section 315 of the Coastal Zone Management Act of 1972 (as amended), the commitments of the 1987 Chesapeake Bay Agreement and its subsequent amendments and the provisions of the Maryland Coastal Zone Management Program. It is also consistent with the goals, objectives, and policies of the National Estuarine Research Reserve System (NERRS). (See Appendix B for regulations.)

### 1.2 National Estuarine Research Reserve System

The National Estuarine Research Reserve System (NERRS) was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. The CZM Program is dedicated to comprehensive, sustainable management of the nation's coasts.

NERRS is a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. NERRS currently consists of 27 reserves in 22 states and territories, protecting over one million acres of estuarine lands and waters.

#### 1.2.1 Mission of NERRS

As Stated in the NERRS regulations, 15 C.F.R. Part 921.1(a), the National Estuarine Research Reserve System mission is:

*the establishment and management, through Federal-State cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.*

## 1.2.2 Goals of NERRS

Federal regulations, 15 C.F.R. Part 921.1(b), provide five specific goals for the reserve system:

- (1) Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
- (2) Address coastal management issues identified as significant through coordinated estuarine research within the System;
- (3) Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- (4) Promote Federal, State, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
- (5) Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

## 1.2.3 National Estuarine Research Reserve System (NERRS) Strategic Goals 2005 – 2010

The reserve system began a strategic planning process in 1994 in an effort to help NOAA achieve its environmental stewardship mission to “sustain healthy coasts.” In conjunction with the strategic planning process, Estuarine Reserves Division and reserve staff has conducted a multi-year action planning process on an annual basis since 1996. The resulting three-year action plan provides an overall vision and direction for the reserve system. As part of this process, the reserve system developed a vision and mission.

**NERRS VISION:** Healthy estuaries and watersheds where coastal communities and ecosystems thrive.

**NERRS MISSION:** Practice and promote coastal and estuarine stewardship through innovative research and education, using a system of protected areas.

The following goals are outlined in the NERRS *Strategic Plan: 2005-2010*.

Strategic Goals:

1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.
2. Increase the use of reserve science and sites to address priority coastal management issues.

3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

#### **1.2.4 Biogeographic Regions**

NOAA has identified eleven distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the reserve system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2006, the reserve system includes 27 reserves and two reserves in the process of designation (Figure 2).

**Figure 2. Map of National Estuarine Research Reserve System**



### **1.2.5 Reserve Designation and Operation**

Under Federal law (16 U.S.C. Section 1461), a State can nominate an estuarine ecosystem for Research Reserve status so long as the site meets the following conditions:

1. The area is representative of its biogeographic region, is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
2. The law of the coastal State provides long-term protection for the proposed Reserve's resources to ensure a stable environment for research;
3. Designation of the site as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and
4. The coastal State has complied with the requirements of any regulations issued by the Secretary [of Commerce].

Reserve boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

If the proposed site is accepted into the reserve system, it is eligible for NOAA financial assistance on a cost-share basis with the State. The State exercises administrative and management control, consistent with its obligations to NOAA, as outlined in a memorandum of understanding. A reserve may apply to NOAA's Estuarine Reserves Division (ERD) for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

### **1.2.6 National Estuarine Research Reserve System (NERRS) Administrative Framework**

The Estuarine Reserves Division (ERD) of the Office of Ocean and Coastal Resource Management (OCRM) administers the reserve system. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

The Estuarine Reserves Division currently provides support for three system-wide programs: the System-wide Monitoring Program, the Graduate Research Fellowship Program, and the Coastal Training Program. They also provide support for reserve initiatives on restoration science, invasive species, K-12 education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

### **1.3 Chesapeake Bay Context**

Being located in the Chesapeake Bay where so many programs by so many partners are underway provides unique opportunities as well as challenges. Communication with other programs in DNR such as the State coastal program and with other State agencies is essential, including Maryland's Department of Planning, Department of Environment, Department of Agriculture, and Department of Transportation. Key partners, in addition to the component partners and NOAA/ERD, include local universities and colleges, informal education centers such as the National Aquarium in Baltimore and the Salisbury Zoo, Sea Grant, Critical Area Commission, Tributary Strategies, Chesapeake Bay Trust, EPA Chesapeake Bay Program, NOAA Chesapeake Bay Program and other NOAA offices, the Mid-Atlantic Coastal and Ocean Regional Association (MACOORA), municipal and county agencies, the business community, and other local entities, including citizen groups and non-profits.

The Reserve will work to leverage opportunities and to encourage and facilitate collaboration to achieve the Reserve mission to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

### **1.4 Key Management Issues**

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows. These losses and alterations affect both: 1) hydrologic and pollutant inputs, and 2) living resource food web dynamics and community structure.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure. These issues have both ecosystem and socio-economic implications. Delaware and Maryland are the third and fourth most vulnerable states to sea level rise after Louisiana and Florida, and the Monie Bay component is located in one of the most vulnerable counties in Maryland.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates). Reserve programs will address issues related to reduced population numbers and species diversity. In addition to the stressors listed above, bacterial contamination, toxic contamination, and invasive species affect these populations and communities.
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities. Losses and changes to these communities will be investigated and addressed. In addition to the stressors listed above invasive species can adversely affect these plant communities and reduce habitat value.

- Healthy water quality/habitat. Key factors that degrade water quality include excessive nutrients and sediments. For example, these factors can cause low dissolved oxygen, less desirable phytoplankton and zooplankton assemblages, and harmful algal blooms.



## **2. CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE IN MARYLAND (CBNERR-MD): DESCRIPTION**

### **2.1 Chesapeake Bay Biogeography and Eco-Region**

The Chesapeake Bay, where the Reserve is located, is the largest estuary in the United States and is one of the most productive bodies of water in the world. It is situated in the mid-Atlantic area of the Atlantic coastal plain in the Chesapeake Bay subregion of the Virginian biogeographic region. Roughly half of the Chesapeake Bay is in the State of Maryland and half in the Commonwealth of Virginia. The watershed of the Chesapeake Bay extends into four additional states: Delaware, Pennsylvania, New York and West Virginia.

The Bay is 180 miles (290 km) long and varies from 3 to 30 miles (5 to 48 km) wide. The average depth of the open Bay is 27.6 feet (8.4 m) and the average depth of the total Bay system including the tributaries is 21.2 feet (6.5 m). The shoreline of the Bay and its tributaries is approximately 8,100 miles (13,000 km) long, and about 4,000 miles (6,400 km) of this is in Maryland. Most of Maryland has a tidal range of 1 to 2 feet (.3 to .6 m). Currents are moderate, usually well below 0.5 knots (0.9 km/hr), although they may reach 1.5 knots (2.8 km/hr) in bottlenecks or upper portions of the Chesapeake. Salinity typically ranges from 0 to 20 parts per thousand (ppt) in Maryland and reaches 30 ppt in Virginia. The bottom sediments range from clayey-silt to coarse-grained sand and gravel.

Maryland is the home of a broad variety of marshes: estuarine river marshes (fresh and brackish), estuarine bay marshes (fresh, brackish, and salt), and coastal embayed marshes. These marshes regulate river flow, help prevent flooding of upland areas, filter nutrients and other pollutants, and provide essential habitats for Chesapeake Bay living resources such as fish, crabs and waterfowl.

Population density and the effects of human development vary greatly in the Bay area. The western and northern shores are generally highly developed, densely populated areas while much of the Eastern Shore is largely agricultural and is sparsely populated. The broad range of environmental conditions in the Chesapeake Bay results in a wide variety of ecosystem types and, in turn, in a tremendous diversity of life.

Approximately 15,000 years ago the warming climate caused North American glaciers to begin to melt and retreat. Melting glaciers caused sea levels to rise gradually, which eventually flooded the lower Susquehanna River valley and created the Chesapeake Bay as we know it today. Artifact dating indicates that bands of territorial, semi-nomadic people lived in Maryland beginning in the Paleoindian Period (11,000-7,500 B.C.). Through the Archaic Period (7,500-1,000 B.C.) the people became more sedentary. Populations climbed as food sources increased with the formation of the Chesapeake Bay and general warming of the climate. During the Woodland Period (1,000 B.C.-A.D. 1,600) people became even more sedentary and living groups changed from temporary hamlets to permanent villages.

European settlement marked the beginning of dramatic changes for the Bay area. The first record of a European visit to the Bay was written by Brother Carrera, a Spanish

priest, in 1572. The first European settlement on the Bay was Jamestown, Virginia, founded in 1607. In 1634, the first European settlers in current-day Maryland landed on St. Clements Island and then founded St. Mary's City. Tobacco imported from the West Indies flourished in the rich soil of the Bay area, and the hope of profit and a new life attracted a multitude of Europeans. Introduction of the plow in the 1790s initiated the largest impact of settlement-soil erosion. Sediments entering the Bay and its tributaries greatly increased, eventually closing off several port cities. Erosion and the deposition of sediments remain an ongoing problem. Shipping, shipbuilding, canning and the seafood industry became major industries for the area.

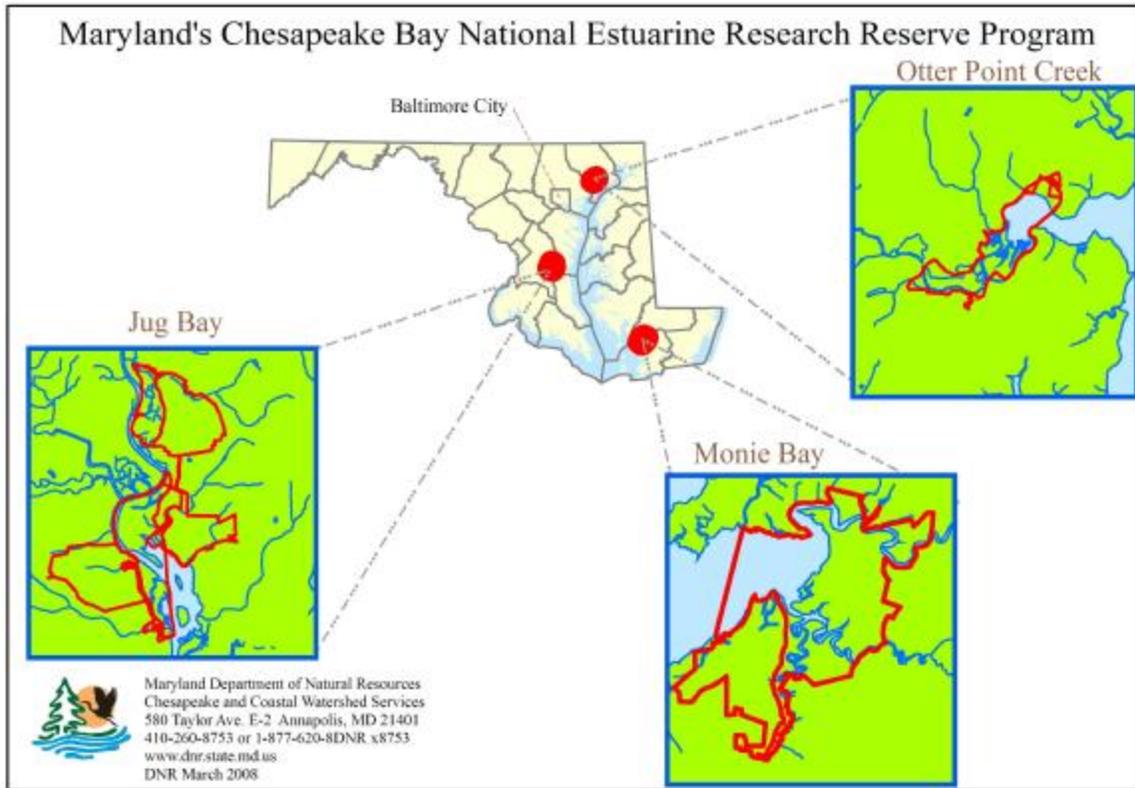
By 2000 Maryland's population exceeded 5,375,000. Most of the population in the State is concentrated around Baltimore, Maryland, and Washington, D.C. Main employment is in manufacturing (especially of electric and electronic equipment), contract construction, retail trade, services, and State and federal government. The Bay system is economically important for shipping, commercial fishing, recreation, tourism, and real estate value. Its commercial fisheries are worth about \$130,000,000 per year in landings and employ thousands of people. The Port of Baltimore generates \$1.4 billion in revenue annually and employs almost 126,700 people.

The Chesapeake Bay region is characterized by a humid, moderate, continental climate with warm humid summers and cold, but not severe, winters. Westerly winds prevail in the mid-Atlantic region of the U.S., bringing most of the weather systems from west to east. The Appalachian Mountains in western Maryland modify weather patterns coming in from the west. This phenomenon combines with the presence of the Chesapeake Bay and the Atlantic Ocean to moderate weather in the area. Precipitation is fairly uniform throughout the year with August being the wettest month and February the driest. Normal annual precipitation varies from thirty-six inches to forty-seven inches (91 cm to 119 cm) in different areas of the State. During the colder months, high and low pressure systems alternate. This results in surges of warm, moist air from the south and east, and cold, dry air from the north and west. These changes in wind direction can cause the weather to change radically from one day to the next. Heavy precipitation during the cold time of year is generally the result of low pressure systems moving north or north-eastward along the Atlantic coast. During the warmer months the Bermuda High, a large semi-permanent subtropical high pressure system, spreads warm humid air northward over the area from the south and southeast. Heavy precipitation during this time of year generally falls in the form of thunderstorms. The average number of thunderstorm days in the area is twenty-nine (29) per year. About seventy-five percent of these occur from May to August.

## **2.2 Description of the Reserve Components**

Within the Virginian biogeographic region, the Chesapeake Bay watershed is represented by Reserves in both Maryland and Virginia. Both states have selected sites representing their area and both states' reserves are called the Chesapeake Bay National Estuarine Research Reserve (one Maryland and one Virginia). Maryland has four components (sites) in the CBNERR-MD and Virginia has four components (sites) in the CBNERR-VA.

The Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) was established in 1985 with the Monie Bay component in Somerset County. In 1990, two additional sites were added—Otter Point Creek in Harford County and Jug Bay in Prince George’s and Anne Arundel Counties. The Reserve’s three components are in geographically distinct locations as shown in Figure 3.



**Figure 3. CBNERR-MD Components (2008 boundaries)**

Today, the three component sites incorporate a total of 4,981 land acres and 1,268 open water acres as summarized in the area summary (Table 1 below). Maryland’s multi-component Reserve reflects the diversity of estuarine habitats found within the Maryland portion of the Chesapeake Bay.

**Table 1. CBNERR-MD Area Summary – Reserve Acres**

Area Summary – Reserve Acres			
Component	Land	Open Water	Total
Otter Point Creek	475	261	736
Jug Bay	1,836	251	2,087
Monie Bay	2,670	756	3,426
Total	4,981	1,268	6,249

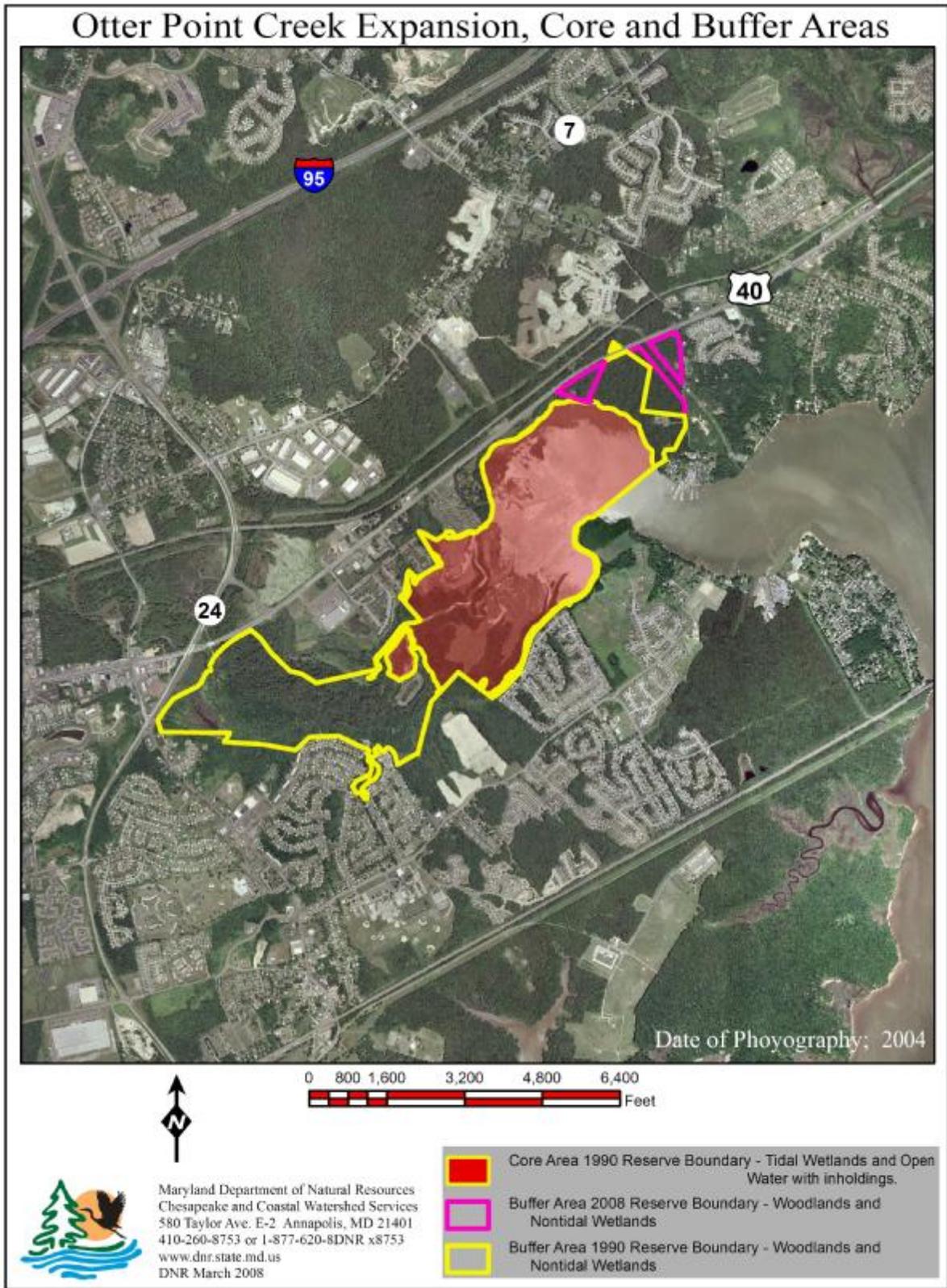
### 2.2.1 Otter Point Creek

The Otter Point Creek component includes a large freshwater tidal marsh, forested wetlands, upland hardwood forests and shallow, open estuarine waters. Otter Point Creek is small arm of the larger Bush River, which is a tidal portion of the Upper Chesapeake Bay. It is located in densely populated Harford County, near the town of Edgewood and near the US Army's Aberdeen Proving Grounds. A large area of suburban road network is found in the watershed that flows into Otter Point Creek.



Otter Point Creek is a small component in a densely populated area with easy access from major roads. The need for public education has been and will continue to be a major focus for the Reserve at this component along with citizen monitoring, stewardship and restoration activities.

The core area of the Otter Point Creek component consists of the estuarine wetland complex located near the headwaters of Otter Point Creek. This includes the tidal marshes east of the old sewage lagoons, tidal creeks and guts running through the marshes, and open water of the creek extending eastward to Otter Point. The core area encompasses one of the few large tidal fresh marshes in the upper Chesapeake Bay that is still in a relatively natural and undisturbed condition. A high diversity of floral and faunal populations is found here, including submerged aquatic vegetation (bay grasses), waterfowl, and mammals. The current core and buffer areas are shown in Figure 4 (Otter Point Creek, Core and Buffer Areas – Original).



**Figure 4. Otter Point Creek, Core and Buffer Areas - Original**

## 2.2.2 Jug Bay

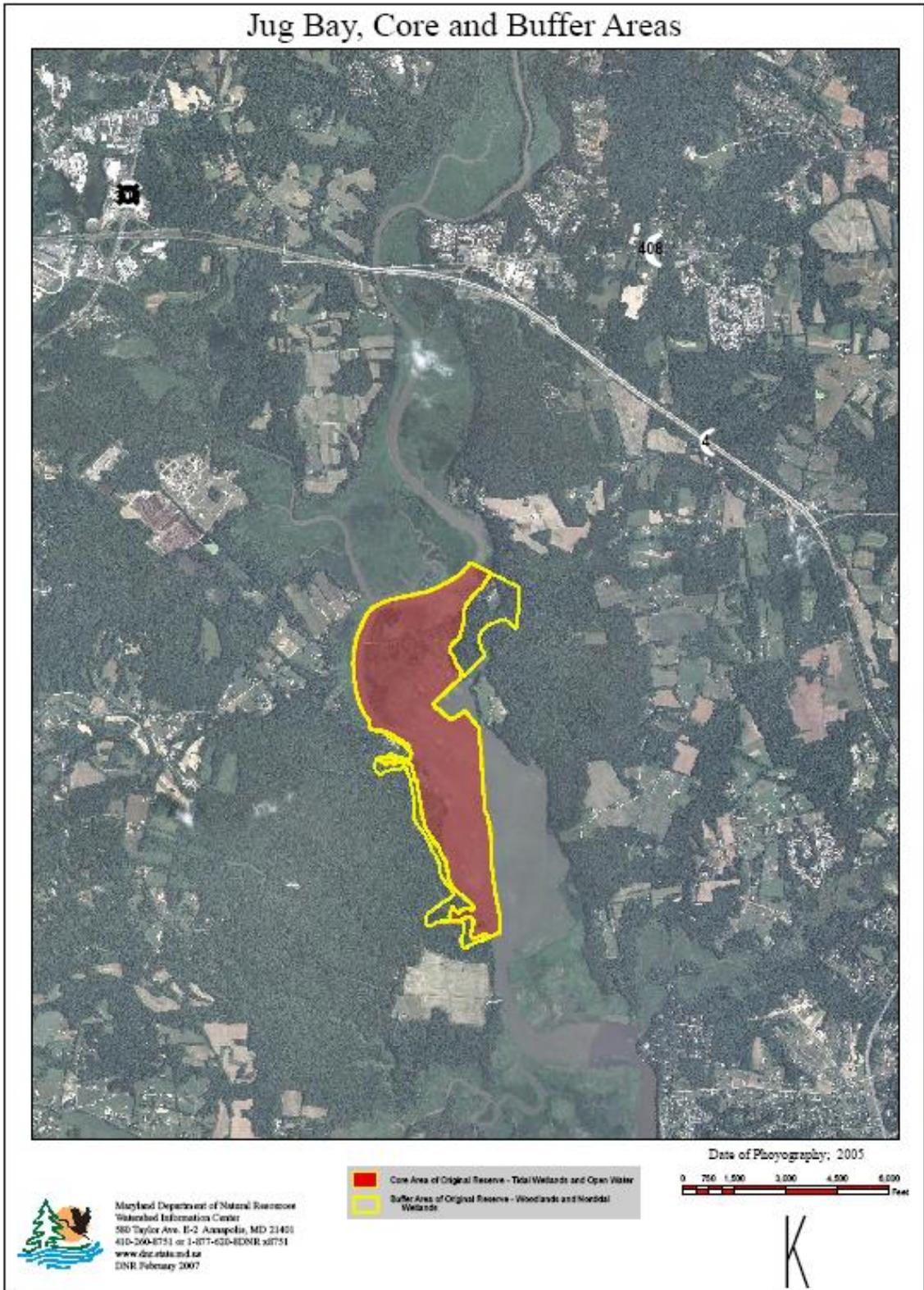
The Jug Bay component consists largely of a shallow, tidal fresh embayment of the Patuxent River, fringing marshes and feeder streams, and adjacent uplands. This Reserve component is near the mid point of the 109-mile long Patuxent River watershed. There is a dense network of suburban and urban roads in parts of the watershed above Jug Bay. The areas surrounding this Reserve component has a mix of natural area, agriculture and development.



Jug Bay is located relatively close to urban centers and is under intense development pressure, yet it is still relatively pristine due to State and MNCPPC preservation efforts along the Patuxent River. Limited access to the Jug Bay Wetlands Sanctuary make it an ideal location for long term monitoring, research, and restoration efforts along with education initiatives.

The core area of the Jug Bay component consists of open water of the Patuxent River and Jug Bay, the tidal portions of Two Run and Black Walnut Creek, and the fringing tidal wetlands along the shoreline. Since this component incorporates property in two counties, the core area in each county was delineated to represent an ecological subunit. Together, these two areas complement each other to form a more diverse, complete ecological unit. The waters of the river and Jug Bay unify the tidal wetlands systems on opposite sides of the shore. As shown in Figure 5 (Jug Bay Core and Buffer Areas – Original Boundary), the core area within the Reserve boundary is comprised of two generalized land use types: tidal wetlands and open water.

The Jug Bay core area provides habitat for a wide diversity of flora and fauna, including over 200 species of birds. Jug Bay is designated as an Audubon Important Bird Area (IBA); over 100 native species are documented as confirmed or probable breeders. Twenty-two species of ducks use the site's wetlands for breeding and wintering. This is also the farthest upriver spawning area for striped bass (*Morone saxatilis*) in the Patuxent River. Several rare and endangered species are found in this area.



**Figure 5. Jug Bay Core and Buffer Areas – Original Boundary**

### 2.2.3 Monie Bay

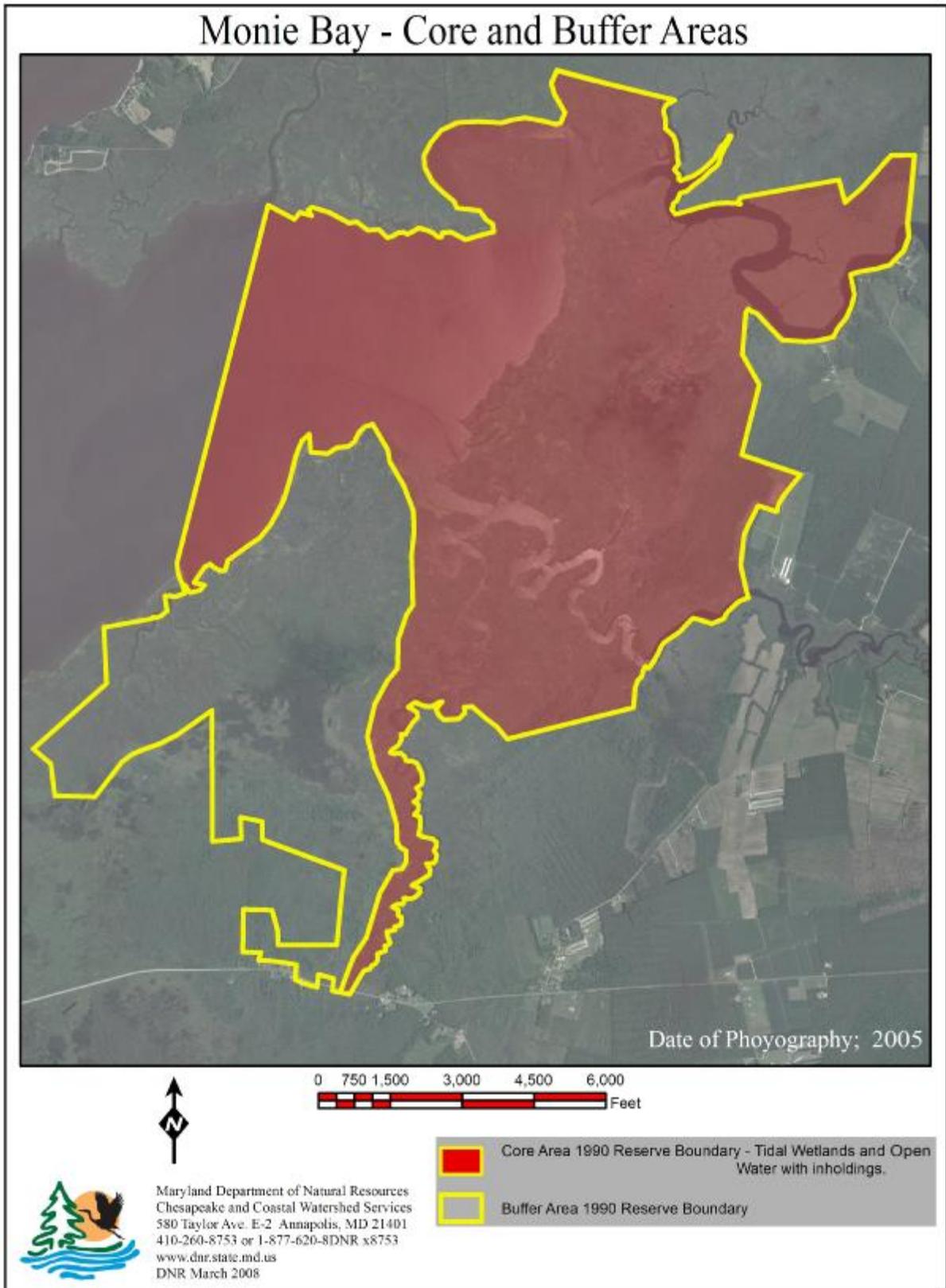
The Monie Bay component lies along the northern side of the Deal Island peninsula in Somerset County. It is comprised of mesohaline saltwater marshes, tidal creeks, pine forests and shallow, open water. The relatively rural area around the Reserve component has three streams that drain the local area. The open water of tidal Monie Bay merges with the Wicomico River before reaching Tangier Sound and the Chesapeake Bay. This Reserve component is in an area that is relatively rural and remote.



Monie Bay's large size, remote location from industrial and urban centers, and proximity to Maryland's eastern shore universities, make it an especially ideal location for research and monitoring. The University of Maryland Center for Environmental Science has used Monie Bay for many studies on marshes, especially involving the impact of nutrients on ecosystem functioning.

The core area includes the open water of Little Creek, Little Monie Creek, and part of Monie Creek; and the salt marshes and uplands extending from the Little Creek watershed to Monie Creek. The core incorporates a very large, pristine, undisturbed ecological unit which includes habitat for many rare and endangered species and provides excellent opportunities for long-term, non-manipulative research.

Figure 6 (Monie Bay - Core and Buffer Areas) shows that the core area encompasses the entire Monie Bay component east of a boundary line. This line was established in a Memorandum of Understanding between the land management entity in DNR and the Reserve management entity in DNR. The map also shows that the core area is mostly tidal wetlands and open water. The buffer area includes the open water of Monie Bay and the marshlands west of the Little Creek watershed. Man-made waterfowl ponds can be found in this area.



**Figure 6. Monie Bay - Core and Buffer Areas – Original Boundaries**

## **2.3 CBNERR-MD Major Accomplishments (1990 to 2008)**

Without a doubt the greatest accomplishment from 1990 to 2008 was the opening of the **Anita C. Leight Estuary Center** at Otter Point Creek in September 1996, followed by the implementation of programming at this site. The Center currently houses offices for a full time naturalist, park manager, receptionist, and CBNERR-MD DNR staff. The Center supports research, education, coastal training, and stewardship programs. Public programs are routinely filled to capacity.

Other sector-specific accomplishments are summarized below. For a more detailed list of accomplishments, see Appendix A.

### **Administration and Staffing Accomplishments**

CBNERR-MD is managed through a cooperative approach involving the Maryland Department of Natural Resources (DNR), Harford County Parks and Recreation, and Harford County Chapter of the Izaak Walton League of America, Maryland-National Capital Park and Planning Commission (MNCPPC), Anne Arundel County Recreation and Parks. State support for the program has fluctuated over the past 16 years, but under the current administration, support for the program is moderately high.

#### **Staffing Accomplishments**

- State funds now support 100 percent of two core Reserve staff positions—Reserve Manager and Education Coordinator.
- Federal funds support two permanent State positions (Research Coordinator and Stewardship Coordinator) and one long-term contractual position (Coastal Training Program Coordinator).
- Since 1990, component staff numbers have grown from 5 to over 12 staff. The Otter Point Creek Site Manager and maintenance staff receive a portion of their salaries from the federal grant; the remainder of those two salaries and all other positions are paid for by local partners.
- CBNERR-MD staff participate in national programs. All CBNERR-MD staff attend NERRS annual and sector meetings and appropriate professional meetings and trainings. The Education Coordinator and Research Coordinator participate in appropriate workgroups.

#### **Administration Accomplishments**

- Jug Bay and Otter Point Creek components were designated in 1990.
- Action plans and strategies were developed in 1999 with the assistance of an Advisory Committee and Reserve and site staff. Updates were completed in 2001, 2002, and 2003.
- A socio-economic study was conducted for the Monie Bay component that identifies the current relationship between the Reserve and the local community and projects future directions for improving that relationship.

## **Research and Monitoring Program Accomplishments**

CBNERR-MD has conducted research and monitoring and provided a protected location for research to address important Maryland coastal issues.

- CBNERR-MD participates fully in the NERR System-wide Monitoring Program (SWMP). CBNERR-MD has made great advances in providing the required SWMP data, and now holds a perfect record for data submission over last three years.
- CBNERR-MD has been a leader in testing and using telemetry technologies, successfully piloting both the RASSL and GOES telemetry systems to bring real-time water quality and weather data to more data users as part of the Integrated Ocean Observing System efforts. The CBNERR-MD Research Technician has served as a Regional Telemetry Technician, providing peer assistance regarding telemetry installation and trouble-shooting to others in the region.
- CBNERR-MD and CBNERR-VA have worked with their State agencies and the EPA Chesapeake Bay Program to expand beyond the four required SWMP stations to bring higher resolution data delivery to data-users. CBNERR-MD provides real-time data through not only the CDMO web site, but also through the Maryland eyesonthebay web site. Eyesonthebay provides data from the four SWMP water quality stations and two weather stations seamlessly with the other 46 continuous monitoring stations and one other meteorological station. In addition, data products such as data visualization tools and lesson plans are provided on the site.
- CBNERR-MD participates fully in the NERR Graduate Research Fellowship Program.
- Extensive research has been conducted in the Reserve since 1990. A few examples include research regarding bay grasses (SAV), wild rice, sora rails; box turtles, nutrient dynamics, and marsh surface elevation (see Appendix J for more details).
- The Cooperative Institute for Coastal Estuarine Environmental Technology (CICEET) has also funded numerous research projects tied to CBNERR-MD (see Appendix J for more details).
- Site staff at Jug Bay Wetlands Sanctuary have made great strides to improve communication among scientists, in the area, for example by hosting the Jug Bay Annual Volunteer Science Symposium.

## **Education Program Accomplishments**

Reserve and site staff work cooperatively to deliver a wide array of educational programs for teachers, students and the public. Science concepts and research methods are taught by providing authentic hands-on learning experiences to hundreds of students annually. The programs have increased in volume to serve over 2,800 K-12 students with over 140 education programs in the last recent grant period (October 1, 2006 to September 30, 2007). CBNERR education program highlights include:

- Wetlands and Wildlife Field Day—Annual education event at Monie Bay for all 4th grade students in Somerset County
- Estuaries Live – hosted in 2002

- Published *Ecology of an Estuary: Chesapeake Bay*, a guide for middle school teachers.
- Developed plankton education programming for the new wet lab at Jug Bay in 2007

A variety of large public education events have been held. Major recent events include:

- NOAA Restoration Day (2007 at Jug Bay),
- Patuxent Sojourn event (2007 at Jug Bay)
- Upper Western Shore Wade-In (hands-on activities provided annually at event at Otter Point Creek)

Education Program funding also supports:

- Maryland State Department of Education Ocean and Environmental Literacy Initiative
- Maryland Green Schools

CBNERR-MD staff have been the recipient of Environmental Heroes Awards:

- Bob Finton, former Education Coordinator, received NOAA's Environmental Hero Award posthumously in 2006, and the Otter Point Creek Finton Laboratory with a Focus on Fun was dedicated in his memory.
- Tara Whittle and Morgan Angus, two volunteers from the Jug Bay Wetlands Sanctuary, were honored in 2003 with NOAA's Environmental Heroes Awards for their research on turtles and salamanders and for their assistance with the Reserve's Estuary LIVE internet broadcast in 2002.

### **Coastal Training Program (CTP)**

The CBNERR-MD Coastal Training Program aims to facilitate informed and improved decision-making by making relevant and cutting-edge estuarine research relevant, meaningful, and accessible to managers and stakeholders through targeted workshops. Following are some accomplishments of the Reserve's Coastal Training Program.

- In 2006, DNR hired a full-time contractual Coastal Training Program Coordinator.
- Coastal Training Program funding was received and the program was launched on October 1, 2007.
- Official approval of Coastal Planning Program documents was received on March 17, 2008.
- In 2008, CBNERR-MD's Coastal Training Program will be fully implemented and receive NOAA program approval.

A few examples of recent coastal decision-maker workshops and CTP trainings include:

### **Coastal Decision-Maker Workshops**

- Deer Management (2005)
- Managing Visitor Use (2006)
- Living Shorelines Summit in Virginia (2006)
- From Backyards to the Sassafras (Bayscaping Workshop) (2007)
- Living Shoreline Summit on Lower Eastern Shore of Maryland (2007)

### **Coastal Training Program Trainings**

- Green Living Workshop at Otter Point Creek (2007)
- Chesapeake Coastal & Watershed Outreach Exchange (2008)

### **Stewardship and Volunteer Program Accomplishments**

#### **Protection**

- CBNERR-MD has protected over 3,600 acres in perpetuity through Memoranda of Understanding and conservation easements at the three reserve components—Otter Point Creek (Harford County), Jug Bay (Prince George's and Anne Arundel Counties) and Monie Bay (Somerset County). This Management Plan proposes to increase that number to over 4,900 acres.

#### **Restoration**

- The highly successful wild rice restoration project at Jug Bay has helped bring back this food source essential to wildlife such as the secretive sora rails.
- Invasive species project over the year include phragmites and purple loosestrife control.

#### **Volunteers**

- The Friends of Jug Bay (established in 1986) has remained extraordinarily active through today.
- The Friends of Otter Point Creek was established in 1997 (later evolved into the current Otter Point Creek Alliance) and supports the activities and interests of Otter Point Creek.
- *Jug Bay Volunteer Guide* and *Volunteer Guide for Otter Point Creek* were published.
- Dedicated volunteers participate in a variety of administrative, research and monitoring, education and outreach, restoration, and construction activities throughout the year at Jug Bay and Otter Point Creek. For details see Appendix J.
- Volunteer Appreciation Events are held annually at Jug Bay Wetlands Sanctuary and at Otter Point Creek.
- In the last grant period (October 1, 2006 to September 30, 2007), the number of volunteer hours at Jug Bay and Otter Point Creek totaled over 4,000 hours.

### **Facility Development Accomplishments**

- At Otter Point Creek, completed the construction and opening of the Anita C. Leight Estuary Center, exhibits, storage buildings, boardwalk, and overlook.
- At Jug Bay (Anne Arundel side), completed the addition to the McCann Center. This addition added meeting space to the main visitor center at Jug Bay Wetland Sanctuary.
- At Jug Bay (Prince George's side), leveraged other funding sources to build wet lab facility and bathrooms showcasing green technologies.
- At Jug Bay (Anne Arundel side), completed renovation of the Plummer House, which provides office and meeting space, and a staging ground for education and research programs at the Glendening Preserve portion of Jug Bay Wetlands Sanctuary.



### **3. CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE IN MARYLAND (CBNERR): MISSION, GOALS AND OBJECTIVES**

#### **3.1 CBNERR-MD and Maryland Department of Natural Resources Vision and Mission**

**CBNERR VISION:** The Maryland Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD or the Reserve) will be established and known as a place where relevant and cutting-edge estuarine research is conducted and Reserve programs make estuarine science relevant, meaningful, and accessible.

**CBNERR MISSION:** The mission of the Reserve is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The Reserve will help achieve the Maryland Department of Natural Resources (DNR) mission key objectives. The mission of DNR is to preserve, protect, enhance and restore Maryland's natural resources for the wise use and enjoyment of all citizens. Key objectives that the Reserve will help achieve are:

- Sustainable Populations of Living Resources and Aquatic Habitat
- Healthy Maryland Watershed Lands, Streams and Non-Tidal Rivers
- Natural Resources Stewardship Opportunities for Maryland's Urban and Rural Citizens
- Conserved and Managed Statewide Network of Ecologically Valuable Private and Public Lands
- Diverse Outdoor Recreation Opportunities for Maryland Citizens and Visitors

These objectives are in pursuit of a vision of a Maryland that honors the interconnectedness of life by striving in all of its actions to safeguard and steward its natural resources for now and for future generations.

#### **3.2 CBNERR-MD Goals**

- Strengthen the protection and management of the Reserve to advance estuarine conservation, research and education.
- Increase the use of science and Reserve sites to address management issues.
- Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.

These CBNERR-MD goals mirror the NERRS goals as written in the NERRS *Strategic Plan: 2005-2010*.

#### **3.3 CBNERR-MD Management Issues**

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows. These losses and alterations affect both: 1) hydrologic and pollutant inputs, and 2) living resource food web dynamics and community structure.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure. These issues have both ecosystem and socio-economic implications. Delaware and Maryland are the third and fourth most vulnerable states to sea level rise after Louisiana and Florida, and the Monie Bay component is located in one of the most vulnerable counties in Maryland.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates). Reserve programs will address issues related to reduced population numbers and species diversity. In addition to the stressors listed above, bacterial contamination, toxic contamination, and invasive species affect these populations and communities.
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities. Losses and changes to these communities will be investigated and addressed. In addition to the stressors listed above invasive species can adversely affect these plant communities and reduce habitat value.
- Healthy water quality/habitat. Key factors that degrade water quality include excessive nutrients and sediments. For example, these factors can cause low dissolved oxygen, less desirable phytoplankton and zooplankton assemblages, and harmful algal blooms.

### **3.4 Goals and Objectives**

The following goals and objectives outline a long-term strategy for accomplishing the Reserve’s mission. These CBNERR-MD goals mirror the NERRS goals and, where appropriate, these CBNERR-MD objectives reflect the NERRS objectives as described in the NERRS *Strategic Plan: 2005-2010*. Specific strategies to meet these objectives are detailed by sector in the following chapters.

#### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

**Objective 1.1 Reserve operations will be improved by ensuring adequate State support, maintaining local support capabilities, and fostering good internal communication.**

**Objective 1.2. Biological, chemical, physical and community conditions of the Reserve will be characterized and monitored to quantify change.**

**Objective 1.3 The long-term integrity and diversity of Reserve habitats will be**

**maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

**GOAL 2. Increase the use of science and Reserve sites to address management issues.**

**Objective 2.1. More scientists will conduct estuarine research at the Reserve.**

**Objective 2.2. Scientists, resource managers, and the general public will have access to NERRS and CBNERR-MD datasets and science products, and the Chesapeake Bay scientific community will use data, tools and techniques generated through NERRS and CBNERR-MD.**

**Objective 2.3. Scientists, professors, and undergraduate and graduate students will have an increased ecological understanding of estuaries and an increased understanding of the relationships among estuaries and human activities, social issues, values, and behaviors through CBNERR-MD research and monitoring.**

**Objective 2.4. The CBNERR-MD Research Program will have increased governmental and community support.**

**GOAL 3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.**

**Objective 3.1. Students and teachers will have an increased estuarine and environmental literacy.**

**Objective 3.2. Maryland's urban and rural citizens will have a high level of awareness of the ecological, economic, historical and cultural importance of estuarine and coastal resources and an increased understanding of how human choices and natural disturbances impact social, economic and estuarine ecological systems.**

**Objective 3.3. Coastal decision-makers will receive knowledge, information, and skills to improve coastal management.**

**Objective 3.4. Coastal decision-makers will use science-based information in making decisions that will affect coastal and estuarine resources.**

**Objective 3.5. Local communities and local governments will have a higher level of support for estuarine and coastal stewardship.**



## 4. ADMINISTRATION

### 4.1 Introduction

An efficient, effective, and well-supported administration is needed to achieve the goals of the National Estuarine Research Reserve System (NERRS) as a whole, as well as the goals of the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) and the Maryland Department of Natural Resources (DNR). CBNERR-MD is managed through a cooperative approach led by DNR and involving Harford County Parks and Recreation, Harford County Chapter of the Izaak Walton League of America, Maryland-National Capital Park and Planning Commission (MNCPPC), and Anne Arundel County Recreation and Parks. One of 27 National Estuarine Research Reserves around the nation, CBNERR-MD is funded 70 percent by NOAA funding and 30 percent by State and local match.

The three geographically distinct components of the Reserve are separated by a significant distance. Each of these components is also located in a different local jurisdiction, which is the primary historical reason that each of the Reserve component sites has a different site ownership and management as summarized in Table 2. Each of these site owners participates in the Reserve through a Memorandum of Understanding with DNR.

<b>Table 2. Management Structure of the Reserve</b>			
<b>Component</b>	<b>Site</b>	<b>Owner</b>	<b>Site Management</b>
Otter Point Creek	Leight Park	Harford County	Parks and Recreation Dept.
	Melvin G. Bosely Conservancy	Izaak Walton League of America (IWLA) Harford County Chapter	IWLA and Harford County Parks and Recreation Dept.
Monie Bay	Deal Island Wildlife Management Area	Maryland Department of Natural Resources	Wildlife and Heritage Division
Jug Bay	Jug Bay Wetlands Sanctuary	Anne Arundel County	Recreation and Parks Department
	Patuxent River Park	Maryland-National Capital Park and Planning Commission	Dept. of Parks and Recreation

See Chapter 10 for detailed ownership maps of the Reserve components.

The Reserve is managed to achieve local, State and federal objectives. Reserve staff coordinate activities and programs that are of interest to one or more sites. Regular meetings between Reserve staff and all Site Managers and staff enable good communication and coordination. However, each component has its own program to meet its research, monitoring, educational and general use needs. These will be described in detail in later sections.

## **4.2 Chesapeake Bay Context: Administration**

The Chesapeake Bay and its tributaries form the cultural and socio-economic heart of Maryland. The Bay itself extends 200 miles (300 km) and its watershed covers 64,000 square miles, including portions of every county in the State and portions of five other states (Virginia, Pennsylvania, New York, Delaware, and West Virginia) as well as Washington, DC. Because of its socio-economic and ecological importance, numerous federal, regional, State, and county agencies, non-profit organizations, and regional associations and commissions are involved in Chesapeake Bay management, research, monitoring, education, outreach, training, protection, and restoration.

A key role of Administration of the Reserve is to ensure strong communication and coordination among the Reserve and other Bay-related programs and entities in Maryland. Strong partnerships will help to minimize duplication of effort, maximize collaboration, and leverage resources.

## **4.3 CBNERR Management Issues**

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

CBNERR-MD Administration will address the identified management issues by supporting appropriate research and monitoring, education and outreach, coastal training, stewardship, land acquisition and construction.

### **4.3.1 Component Specific Management Issues at the Chesapeake Bay NERR MD**

Site specific management issues for focus in the near term include the following.

#### **4.3.1.1 Otter Point Creek**

The Otter Point Creek component is heavily impacted and influenced by a rapidly developing watershed. Urbanization within the Winters Run watershed has the potential to bring increasing loads of sediment and nutrients to the component. Urbanization is expected to increase. For example, the US Army Base Realignment and Closure (BRAC) is expected to bring over 45,000 new jobs to Maryland, including over 10,000 to Harford County.

The component sits at the tidal interface of the Bush River and the Winters Run tributary, which contributes the majority of freshwater flow to the system. In addition to the strong influence of the upstream area, Otter Point Creek is also impacted tidally from downstream sources of pollution. There are two wastewater treatment plants that discharge directly into the tidal Bush River and thus have the ability to impact water quality in the Otter Point Creek area.

Future management of the component will need to consider how to mitigate the effects of a rapidly growing population and increased development in the watershed. Increasing sediment and nutrient loads as well as elevated fecal and bacterial concentrations at the site and within the Bush River system are an immediate concern. It should be noted that with the completion of a Bush River Watershed Restoration Action Strategy (WRAS) in 2003, which represented a partnership between the DNR and Harford County, the State of Maryland focused increased attention on identifying sources of pollutants to the Bush River with the goal of targeting appropriate restoration activities and best management practices.

#### **4.3.1.2 Jug Bay**

The Jug Bay component is comprised largely of freshwater tidal wetlands in the broad floodplain of the tidal Patuxent River floodplain. While the Patuxent River watershed contains large areas of suburban and urban development in the mid and upper sections of the watershed, there are large tracts of forests, agricultural lands and wetlands in the mid and lower parts of the watershed. The Jug Bay area consists of the largest series of publicly owned tidal parklands (both State and county-owned lands) in the State of Maryland.

The Patuxent River is eutrophic due to large inputs of anthropogenic sources of nitrogen and phosphorus from wastewater treatment plants, agricultural fertilizers, and atmospheric deposition. Water quality at the site is driven in part by the vast tidal freshwater marshes that have the capacity to help reduce contaminants and aid in biological processing at the site. Additionally, water quality is heavily influenced by the rapid movement of water and tidal flux associated with the mainstem of the Patuxent River. The mainstem water quality is heavily influenced by a large wastewater treatment plant that discharges treated effluent into Western Branch, a tidal tributary of the Patuxent River with confluence just above Jug Bay. As of 2003, the Western Branch Wastewater Treatment Plant discharges over 20,000,000 gallons per day (20 mgd). The wetlands at Jug Bay help improve water quality via the microbially-mediated process of denitrification that takes place in tidal sediments, and the seasonal uptake of nutrients by emergent and submerged aquatic plants during the growing season

Future management of the area should focus on 1) effects of land use change and mitigation efforts on upstream waters; 2) impacts of wastewater treatment effluent on local water quality; 3) effects of migratory waterfowl on marsh vegetation, nutrient concentrations and fecal coliforms at the site, and 4) how changes in sediment accretion rates and/or sea level rise may alter marsh habitat.

#### **4.3.1.3 Monie Bay**

The Reserve at Monie Bay represents a large tidal saltwater marsh ecosystem on the Deal Island peninsula of Maryland's Eastern Shore. The Monie Bay watershed is relatively undeveloped with limited agricultural activities. Water quality at the site is driven in part by tidal flow from the Chesapeake Bay mainstem as well as vast tidal saltwater marshes and creeks that make up the watershed. The site is comprised of three main tidal tributaries, Little Monie Creek, Monie Creek and Little Creek, which range in salinity from mesohaline to oligohaline. Somerset County is one of the most vulnerable counties to sea level rise in Maryland, and subsidence, relative sea level rise, and erosion are important processes affecting Monie Bay.

In addition to their range in salinity, they also differ in the amount of development (specifically agricultural) that impacts each creek. Monie Creek is the largest of the three creeks and has a large freshwater input as well as high agricultural input. Little Monie Creek is slightly smaller with less freshwater input causing salinity to be higher at 10-12 ppt and has moderate agricultural input. Little Creek is the smallest of the three tributaries and has less freshwater inflow and increasing tidal influence with salinity ranging from 12-13 ppt and no agricultural or other development within the watershed. The three different tributaries with their differences in salinity and agricultural input provide a natural experimental design that lends itself to comparison research.

Future management of the area should focus on 1) effects of land use, land use change, and best management practices on the tidal creeks; 2) impacts of varying water quality on aquatic species; and 3) how changes in sea level rise may impact the marsh ecosystem.

#### **4.4 CBNERR-MD Administration Goals, Objectives and Strategies**

Effective administration is key to fulfilling the CBNERR-MD mission. The Reserve's mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The following are a set of objectives and strategies identified as part of the Reserve administration, for which the Reserve Manager and Fiscal Officer have primary responsibility. These objectives and strategies particularly support CBNERR-MD goal one.

#### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

**Objective 1.1. Reserve operations will be improved by ensuring adequate State support, maintaining local support capabilities, and fostering good internal communication.**

Strategy: Increase the visibility of the Reserve within State and local management agencies and organizations.

- Continue to develop working relationships with various groups within DNR, such as the Office for a Sustainable Future, Tidewater Ecosystem Assessment, Monitoring and Non-tidal Assessment, Fisheries, and other groups within the Watershed Services Unit, such as Coastal Zone Management, Tributary Strategies, and Green Infrastructure.
- Take a stronger leadership role within the Department in translating science to citizens and decision-makers on key topics of growth/development and climate change.
- Make presentations about the Reserve and its work to various members of upper level management.
- Encourage Reserve staff to participate in meetings with research communities (such as the Chesapeake Bay Program's Monitoring and Assessment Committee and relevant associated subcommittees and workgroups) and education communities (such as the Maryland Association for Environmental and Outdoor Education, and DNR's Education Matrix Team).

Strategy: Update the Management Plan as appropriate and necessary (ideally, every five years).

Strategy: Work with Site Managers to develop the Reserve annual work plan.

Strategy: Facilitate good communication and team spirit:

- Encourage DNR staff (CBNERR-MD Manager, Research Coordinator, Education Coordinator, Stewardship Coordinator, and CTP Coordinator) to attend weekly staff meetings at DNR Tawes Building regularly.
- Set up regular weekly days on site for Education Coordinator, Stewardship Coordinator, and Research Coordinator.
- Develop ways for Reserve staff to stay connected regardless of where they are working on a given day (e.g., cell phones, laptop computers, internet calendar).
- Encourage DNR staff to participate frequently in on-site activities.
- Invite Site Managers, site staff, Graduate Research Fellows, interns, and SWMP staff to also attend events at other sites and at Tawes whenever possible.
- Hold quarterly meetings with DNR staff, Site Managers, and appropriate site staff. Include topical interest (speakers or field trip) as well as administrative session.

Strategy: Work to achieve and maintain full staff levels (including administrative/fiscal officer position), to attract and retain high-quality staff, and to gain staff positions identified in "future staffing needs."

**Objective 1.3. The long-term integrity and diversity of Reserve habitats will be**

**maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

Strategy: Work with partners to reach agreement on the intent of the MOUs and to ensure that all partners are aware of and actively working to fulfill the MOUs.

Strategy: Formally incorporate newly protected (through MOUs and/or conservation easements) properties at Jug Bay and Otter Point Creek Components into the reserve boundaries (see boundaries and acquisition in Chapter 10 for details).

Strategy: Work with Stewardship Coordinator, other DNR CCWS staff, DNR Aquatic Resources director, Program Open Space, the Conservation Fund, and others to develop relationships and acquire or protect suitable properties that help protect the integrity of the Reserve.

- Ensure that Maryland's Coastal and Estuarine Land Conservation Program (CELCP) plan includes protection of the integrity of the Reserve components.
- Ensure that Program Open Space's targeting plan considers protecting the integrity of the Reserve components.

Strategy: Work with Office of Sustainability to help DNR and the State of Maryland lead by example by implementing environmental design, green building, and green office practices.

Strategy: Work with partners to help build support and capacity for environmental design/green building/LID at the sites and up into the watersheds of the Reserve components and beyond.

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Work with Stewardship Coordinator, other DNR CCWS staff, DNR Aquatic Resources director, Program Open Space, the Conservation Fund, the CELCP staff, and others to develop relationships and acquire or protect suitable properties that enhance the utility of the Reserve.

- Ensure that Program Open Space's targeting plan considers the Reserve's need for a suitable building site with road and water access on high ground for a Research/Education/Cultural Visitor Center at Monie Bay.

## **4.5 Administrative Approach and Management Structure**

### **4.5.1 Federal/State Relationship**

The Estuarine Reserves Division of the Office of Ocean and Coastal Resource Management (OCRM) of NOAA administers NERRS. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national

level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

The Estuarine Reserves Division currently provides support for three system-wide programs: the System-wide Monitoring Program, the Graduate Research Fellowship Program, and the Coastal Training Program. They also provide support for reserve initiatives on restoration science, invasive species, K-12 education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

Operations funding is provided by ERD with a 70:30 match required—70 percent of CBNERR operating funds are provided by NOAA, and the 30 percent match is provided by DNR's Chesapeake and Coastal Watershed Services (CCWS) and Resource Assessment Service (RAS) and by Harford County. In addition to operating funds, CBNERR-MD can compete annually with other National Estuarine Research Reserves for ERD construction and acquisition grants.

#### **4.5.2 State Agency: Maryland Department of Natural Resources (DNR)**

CBNERR-MD is housed in the Maryland Department of Natural Resources (DNR) Aquatic Resources, Chesapeake and Coastal Watershed Services Unit (CCWS). As noted in Chapter 3, the DNR's mission is to preserve, protect, enhance and restore Maryland's natural resources for the wise use and enjoyment of all citizens. DNR's Aquatic Resources Programs are charged with protecting, restoring and enhancing the Chesapeake and Coastal Bays and Maryland's tributaries. CCWS, in particular, collaborates with public and private partners in an effort to develop and support watershed management strategies for the restoration, protection and economic vitality of the Chesapeake and coastal ecosystems. This unit also coordinates the agency's administration of Coastal Zone Management Act funding and conservation education; develops and implements Bay restoration policy, acting as liaison to the Chesapeake Bay Program and the Governor's Bay Cabinet; coordinates Maryland's ten Tributary Strategy Teams; and provides department-wide geographic information services. The placement of the Research Reserve within this unit allows for collaboration between the Research Reserve and the various programs within DNR and in particular CCWS.

A number of other State agencies are involved in various aspects of the Reserve. Within DNR, several units work closely with the Reserve:

- Wildlife and Heritage Service manages the Monie Bay component in cooperation with Reserve staff. A Memorandum of Understanding (MOU) was signed between the Forest, Parks and Wildlife Service and the Tidewater Administration in 1985 to formalize this relationship.
- Tidewater Ecosystem Assessment within the Resource Assessment Service conducts the System-wide Monitoring Program and assists with data analysis.
- Program Open Space is responsible for land acquisition, public parks and public investment in protecting open space, including negotiations, and for site planning and construction design. Two other Maryland State agencies, the Department of Planning and Department of General Services also play a role in land acquisition activities.

- Rural Legacy Program provides funding for open space protection (fee simple or easement) in selected Rural Legacy Areas that are identified by counties and approved by the State. For example, the Glendening Preserve portion of the Jug Bay component is protected by a conservation easement held by DNR’s Rural Legacy Program.
- Maryland Environmental Trust, which is a quasi-public agency administered within DNR, holds conservation easements and may be involved in conservation easements associated with the Reserve.

### 4.5.3 Local Governments

Memoranda of Understanding (MOUs) are in effect with local government partners that further define management roles within the Reserve. See also Chapter 8 for maps and detailed breakdown of acreages owned and managed by different entities. Two of Maryland’s three components have management responsibility that rests with local government working in cooperation with the Reserve as summarized below:

- Otter Point Creek component
  - Harford County Department of Parks and Recreation is the owner and manager of Leight Park (125 acres). An MOU was signed in 1990 by Harford County and the Maryland Department of Natural Resources and addended in 2007 (Appendices D.1 and D.2).
  - Harford County Chapter of the Izaak Walton League of America (IWLA) is the owner of the Melvin G. Bosely Conservancy property with management in cooperation with the Harford County Department of Parks and Recreation. This property includes 260 acres of the original Bosely Conservancy and an additional 90 acres of wetland property in the Otter Point marsh (transferred from the Chesapeake Bay Foundation to the Izaak Walton League on January 31, 1990) for a total of 350 acres. The land is protected under a conservation easement held by the Maryland Environmental Trust (Appendix D.3).
- Jug Bay component
  - Anne Arundel County – Jug Bay Wetlands Sanctuary
    - § Anne Arundel County owns the Reserve lands east of the Patuxent River, and they are managed by the Anne Arundel County Department of Recreation and Parks
    - § Management is detailed in a Memorandum of Understanding (MOU) signed by the Anne Arundel County Executive, the Anne Arundel County Director of Recreation and Parks, and the Secretary of the Maryland Department of Natural Resources (DNR) on July 19, 1990 and addended on September 15, 2006 (Appendices F.1 and F.2).
  - Maryland-National Capital Park and Planning Commission (MNCPPC) – Jug Bay Natural Area in Patuxent River Park
    - § MNCPPC is the land owner and manager of Reserve lands in Prince George’s County, which is on the west bank of the Patuxent River. (MNCPPC is a “bi-county agency empowered by the State of Maryland in 1927 to acquire, develop, maintain, and administer a regional system of parks in Montgomery and Prince George’s Counties, and to prepare and administer a general plan for the physical development of the two counties.”)
    - § Management is detailed in a MOU between DNR and MNCPPC signed on

July 17, 1990 and added in 2007 (Appendices E.1 and E.2).

#### **4.5.4 General Policies**

General policies of CBNERR-MD are highlighted in the following subsections. More specific policies are detailed throughout this management plan in the appropriate sections, (e.g., specific research policies are detailed in the Research section).

Reserve activities and facilities at all sites augment and help support the conservation, research, monitoring, education, stewardship and other functions of the basic programs operated by the site property owners. Programs are complementary to the traditional public recreational uses of the area.

Unless otherwise Stated in a Memorandum of Understanding (MOU) or other management document, site property owners continue to fund, operate, and administer their lands and facilities, including those portions designated as the Reserve, and continue to conduct activities and programs under their mandate. Reserve status does not limit an owner's ability to conduct such activities as long as the activities do not adversely affect implementation of the management plan, conflict with reserve goals, or have any adverse impact on the natural resources of the Reserve.

CBNERR-MD uses a cooperative approach involving DNR, site property owners, local government agencies, and private organizations. Federal and State funding may be used for capital improvements, such as the construction of Reserve facilities or improvement of access roads and trails, as detailed in this management plan.

CBNERR-MD budget and program activities plan follow the federal fiscal year, October 1 to September 30. Reserve staff working through DNR coordinate the distribution of federal and State operational funds and act as a liaison between NOAA and the various agencies and organizations involved in Reserve programs.

Present levels of traditional, compatible uses at and adjacent to components continue as provided for by local or State law. The activities of adjacent property owners will not be restricted by Reserve designation.

Land for the Reserve will be brought under State control only through agreements with willing participants or through fee simple acquisition from willing sellers. The State will NOT use condemnation procedures to acquire land for the Reserve.

#### **4.5.5 CBNERR-MD Staff**

An adequate staff is essential to meet the needs for research, monitoring, restoration, interpretation, education, stewardship, and administration of the Reserve. Staffing needs are being met through a combination of support from federal, State, county government and private organizations. The Reserve program is coordinated by a Reserve Manager. Each designated component also has a Site Manager who works for the local partner. Functional duties are sometimes shared among multiple staff. There are five core Reserve positions: Manager, Research Coordinator, Education Coordinator, Stewardship

Coordinator, and Coastal Training Program Coordinator.

The Reserve core staff are employees of the Maryland Department of Natural Resources. Site partner staff are supported largely by local funds, with the exception of the Site Manager and maintenance worker at Otter Point Creek (who receive NERRS federal funds) and the Monie Bay Site Manager (who is supported by DNR's Wildlife and Heritage Program). Site staff work for their respective agencies, and thus their first priority is to achieve their own agency's goals, but they also provide invaluable efforts in management, research, education, and stewardship necessary to achieve the goals and objectives of the Reserve as a whole. A summary of positions follows:

- State (DNR) funds support 100 percent of two core Reserve staff positions—Reserve Manager and Education Coordinator.
- Federal (NERRS operating) funds support three additional core Reserve positions—Research Coordinator, Stewardship Coordinator, and Coastal Training Program Coordinator.
- Since 1990, component staff numbers have grown from 5 to over 12 staff. Except for the Otter Point Creek Site Manager and maintenance, who receive a portion of their salaries from the federal grant, and the Monie Bay Site Manager, who is paid by DNR, all positions listed below are paid for by local partners.
  - Otter Point Creek
    - § Site manager - Director of Anita C. Leight Estuary Center
    - § Full-time naturalist
    - § Two part-time secretaries
    - § Maintenance
  - Jug Bay
    - § MNCPPC in Prince George's County
      - Site manager - Director of Patuxent River Park
      - Two full-time naturalists
      - Maintenance
    - § Anne Arundel County
      - Site manager - Director of Jug Bay Wetlands Sanctuary
      - One full-time and two part-time naturalists
      - Secretary
      - Maintenance
  - Monie Bay
    - § Site manager – Manager of Deal Island Wildlife Management Area

Following are descriptions of the current DNR CBNERR-MD staff positions and the Site Manager positions.

#### **4.5.5.1 Reserve Manager**

The Reserve Manager works from the Department of Natural Resources headquarters in Annapolis and coordinates administrative and programmatic functions of the Reserve. The Manager also acts as liaison with NOAA, other NERR programs, and Site Managers. Specific duties of the manager include:

- Develop annual and long term strategy and action plans to meet the goals and objectives of the Reserve.
- Prepare annual work plan and budget for State and federal funds and oversee expenditure of funds.
- Guide all program elements, including facility development, land acquisition, educational programs, research and monitoring activities, stewardship and restoration, coastal training, and volunteer programs.
- Supervise activities of the Reserve staff.
- Work with Site Managers, advisory committees, other State agencies, local jurisdictions and other interested parties on issues involving Reserve policy, planning and operations.
- In the absence of a Research Coordinator, Education Coordinator, or Stewardship Coordinator, the manager will assume or delegate the responsibilities of the vacant position(s).

#### **4.5.5.2 Research Coordinator**

Research and monitoring form the cornerstone of the National Estuarine Research Reserve program. Information is collected and made available to increase understanding of the processes of estuarine ecosystems and the effects of human activity on these processes. This understanding is essential for the best management of these extremely productive, but threatened, ecosystems.

To achieve this goal, a Research Coordinator is responsible for coordinating research and monitoring activities for the Reserve. This staff person is located at the Tawes Building in Annapolis, splits time and effort among the three components and works closely with the Reserve Manager, NOAA Research Coordinator, CBNERR-MD Site Managers, all CBNERR-MD staff and other relevant DNR staff (e.g., staff who implement the NERR System-wide Monitoring Program—SWMP—Phase I water quality and weather station monitoring). Specific duties include:

- Lead and oversee the research and monitoring efforts of the Reserve to ensure continuity.
- Ensure implementation of the Reserve's System-wide Monitoring Program, a national program supported by the National Oceanic and Atmospheric Administration.
- Synthesize and translate research information to support the education and outreach efforts of the Reserve.
- Develop and implement Reserve-wide and site-specific research and monitoring projects.
- Serve as liaison with the scientific community to promote the Reserve and align Reserve research and monitoring efforts with key players such as the U.S. Environmental Protection Agency (EPA's) Chesapeake Bay Program, NOAA's Chesapeake Bay office, and various universities.
- Work with universities to encourage the use of components for appropriate research.
- Seek funding for research in the Reserve.
- Represent the Reserve and its interest in applied research in various meetings with stakeholders, internal DNR committees, and NOAA committees where appropriate.
- Guide and direct research interns (including Otter Point Creek Alliance research

interns) and NOAA/NERRS Graduate Research Fellows.

#### **4.5.5.3 Education Coordinator**

The education, interpretation and coastal training components of the Reserve are an integral part of heightening the awareness and understanding of estuaries. Teaching the public about the value of estuaries and what can be done on an individual or collective level to help protect estuarine resources is one element of the education plan. Another important element is the dissemination of research and monitoring results and their management implications to teachers, students, and the public.

The Education Coordinator is responsible for coordinating educational activities for the Reserve. This staff person is located at the Tawes State Office Building in Annapolis, coordinates system-wide education and interpretation programs and splits time and efforts among the three components. The Education Coordinator works closely with the Reserve Manager, the other Reserve staff, Site Managers, and other staff to develop or improve on-site education programs, curricula, and outreach programs; to organize workshops and special events; and to work with scientists to make their research results meaningful to decision-makers and the public. The Education Coordinator is the Reserve's liaison with the Estuarine Reserves Division staff on education issues.

Specific duties of the Education Coordinator are:

- Plan, direct and implement educational activities at the three components of the Reserve and interpret research information for the students, teachers, and the public.
- Design, organize and conduct teacher training workshops, as appropriate.
- Ensure that education priorities are based on program evaluations and assess programs based on those evaluations and implement changes as needed.
- Network with research and education staff from Reserves across the country, education associations, university staff, community groups and private organizations to coordinate the delivery of research-based information.
- Conduct programs for a variety of audiences.
- Serve as liaison with the local, State, and regional education community to promote the Reserve and align Reserve education efforts with key programs and initiatives.

#### **4.5.5.4 Stewardship Coordinator**

The Stewardship Coordinator works to (1) protect and restore the Reserve components for long-term research and education, and (2) foster a sense of stewardship in Marylanders through volunteer programs. The Stewardship Coordinator divides time and efforts among the three components.

Specific duties of the Reserve Stewardship Coordinator are as follows:

- Work to ensure protection and restoration of the Reserve components, including:
  - Work with the Reserve Manager to ensure that protection documents (such as Memoranda of Understanding and conservation easements) are updated and adequate to protect the Reserve components.
  - Keep apprised of activities in the Reserve watersheds that may impact the integrity of the Reserve components and work with Reserve staff and others to

- mitigate or study/document any impacts to the Reserve.
- Lead restoration efforts in the components and train volunteers to assist with these efforts.
- Help with land stewardship and resource management issues at the components.
- Work with site staff and the Reserve Research Coordinator to develop and implement a comprehensive volunteer monitoring program. Program may include, but is not limited to: water quality, submerged aquatic vegetation (bay grasses), reptiles and amphibians, fish, benthic macroinvertebrates and birds. A special emphasis is placed on volunteer monitoring programs that provide valuable data to the Reserve and to other groups within DNR.
- Develop and implement a volunteer action plan for the Reserve to provide training and education for volunteers.
- Assist with volunteer field trips and events.
- Promote the visibility and transfer of information about the Reserve and translate pertinent scientific information to a variety of audiences, including volunteers and other community participants.
- Oversee GIS projects, including mapping habitat change over time.
- Assist with research and monitoring efforts.

#### **4.5.5.5 Coastal Training Program Coordinator**

The Coastal Training Program is integral to the Reserve's ability to improve coastal resource management by translating scientific information about estuarine systems and making it relevant, meaningful, and accessible to professionals responsible for making decisions about coastal resources.

The Coastal Training Program Coordinator oversees the development of the Coastal Training Program (CTP) and is the Reserve's liaison with the Estuarine Reserves Division staff on coastal training issues.

Specific duties of the CTP Coordinator are:

- Coordinate the Coastal Training Program Advisory Committee.
- Coordinate with relevant programs in the Chesapeake Bay region and foster appropriate partnerships.
- Interpret research information for the target audiences identified by the Market Analysis.
- Complete and regularly update CTP planning documents, including Market Analysis, Needs Assessment, CTP Strategy, and Marketing Plan.
- Design, organize and conduct CTP workshops, conferences and training for coastal decision-makers.
- Conduct pre- and post-evaluations of coastal trainings to ensure they are meeting the needs of the target audience and implement changes as needed.
- Network with staff from Reserves across the country, professional and scientific associations, university staff, professional staff from various federal and State agencies, local governments, community groups and private organizations to coordinate the delivery of research-based information.

#### **4.5.5.6 Administrative/Fiscal Officer**

(Goal 1, Objective 1.1)

A dedicated Administrative/Fiscal Officer is needed to conduct all fiscal duties for CBNERR-MD, provide administrative and technical assistance in preparing and submitting grant applications and proposals, provide layout and document management for large documents (e.g., management plans, 312 evaluation materials, action plans) and outreach materials (e.g., brochures, displays), conduct registrations for events and trainings, update contacts and volunteer databases and mailing lists, conduct mailings, complete travel paperwork and arrangements, oversee timesheet submission, arrange logistics (meeting space, food, transportation, etc.) for events, meetings and programs, provide AV setup and assistance, maintaining knowledge of CBNERR-MD schedule knowledge for upper level management and public call-ins and walk-ins, take phone duty, enter information into documents, spreadsheets, and databases, inventory tracking and record-keeping assistance, data entry, typing, and photocopying.

#### **4.5.5.7 Site Managers**

Site Managers retain all management and supervision of site staff, but work with Reserve staff to implement research, monitoring, restoration, education and volunteer activities that are mutually beneficial and help meet the CBNERR-MD goals and objectives. There are four meetings of all Site Managers and Reserve staff annually, and Site Managers are encouraged to attend all of these meetings. Meetings are designed to provide professional development opportunities for all staff with an emphasis on current research findings. Updates about programmatic activities also are included on the agenda. Site managers are also encouraged to work with each other on issues of common concern and to jointly develop activities and programs that cross site boundaries. The four Site Managers are as follows:

- Otter Point Creek component: Harford County Anita C. Leight Estuary Center manager
- Jug Bay component:
  - Anne Arundel County Jug Bay Wetlands Sanctuary Director
  - Maryland-National Capital Park and Planning Commission Patuxent River Park Director
- Monie Bay component: Deal Island Wildlife Management Area manager

Additional future staffing needs are described in Section 4.7 below.

#### **4.5.6 Management and Protection of Reserve Components**

See Chapter 10 (Stewardship—Resource Protection & Management) for information on Memoranda of Understanding and conservation easements and other documents that protect the Reserve areas.

#### **4.5.7 Facilities Summary**

Reserve staff have office space in the Maryland DNR headquarters, which is the Tawes State Office Building in Annapolis, Maryland. This is central to the three Reserve

components and is approximately 30 miles from Jug Bay, 50 miles from Otter Point Creek, and 100 miles from Monie Bay.

In addition to the main office in Annapolis, the Reserve also uses building space at the Jug Bay and Otter Point Creek components. The Anita C. Leight Estuary Center, in Harford County's Leight Park, which is part of the Otter Point Creek component, is one of those spaces. In addition to serving Harford County's needs for environmental education and outreach, this facility provides Reserve office space and the capability for conducting and coordinating education, research, monitoring and public outreach.

Another important facility in the Reserve is the Visitor Center and headquarters building in Patuxent River Park in Prince George's County, which contributes part of the Jug Bay Component. These facilities are operated by Maryland-National Capital Park and Planning Commission. These facilities are valuable staging areas for research, monitoring and education/outreach.

A third key facility for the Reserve is the McCann Wetlands Study Center in Anne Arundel County's Jug Bay Wetlands Sanctuary, which is part of the Jug Bay Component. In addition to serving as the headquarters and central programming hub for the Sanctuary, this facility is a key staging facility for the Reserve's efforts at Jug Bay including research, monitoring and education/outreach.

The final notable facility is the recently renovated (2008) Plummer House, which serves as office and meeting space at the Glendening Preserve portion of Anne Arundel County's Jug Bay Wetlands Sanctuary.

See Appendix I for a table of existing facilities on the Reserve.

#### **4.6 Key Partners**

Key partners in Administration include the Chesapeake and Coastal Watershed Services (CCWS) and DNR upper management, fiscal and administrative staff, DNR Human Resources, Site Managers, site staff, and the State and local agencies associated with each of the sites (Harford County Parks and Recreation, the Maryland-National Capital Park and Planning Commission, Anne Arundel County Recreation and Parks, and DNR's Wildlife and Heritage).

#### **4.7 Future Direction**

Support from CCWS and DNR upper management, fiscal and administrative staff, and DNR Human Resources is essential to the success of the Reserve. Only high priority programs that are managed well weather tight State budgets, the elimination of positions, and hiring freezes. A history of CBNERR-MD DNR vacancies being unfilled and reclasses being rejected has manifest itself in the past in poor staff retention followed by substandard or non-existent programming.

An adequate staff is essential to meet the needs for research, monitoring, restoration, interpretation, education, stewardship, and administration of the Reserve. Staffing needs

are being met through a combination of support from federal, State, county government and private organizations. Current and future staffing needs are described in detail in Section 4.5.5 above. Core sector positions are currently filled, but the Administrative/Fiscal Officer position for the Reserve has been eliminated. This situation will be remedied as quickly as possible.

Reserve staff will continue to work to demonstrate the value of the Reserve to CCWS, DNR, and the State of Maryland as a whole, while simultaneously working with managers, fiscal and administrative staff, and Human Resources to navigate obstacles to success.

#### **4.7.1 Future Staffing Needs**

Additional positions are needed to achieve the CBNERR goals and objectives.

##### **Monie Bay Curator**

(All goals and objectives)

Due to the distance of the Monie Bay site from the Annapolis office (where CBNERR-MD DNR staff are based), a Monie Bay Curator is needed to assist the Deal Island Wildlife Management Area Manager (Monie Bay Site Manager) in fully realizing the potential of this component, and in achieving all of the CBNERR-MD goals and objectives at this component. The Monie Bay Curator would develop partnerships in Somerset County; seek funding to support land acquisition, construction and operations; and oversee land acquisition, facilities construction, and program operations at Monie Bay.

##### **Volunteer Coordinator**

(Goal 2: Objective 2.4; Goal 3: Objectives 3.2 and 3.5)

A Volunteer Coordinator to expand the pool of volunteers to both (1) provide labor for research, education, and stewardship programs, (2) expand the diversity of the volunteer pool, and (3) foster a sense of stewardship for estuarine resources in the broader community. This position would work to assist/develop volunteer programs at all three components, but would be based at the Otter Point Creek site.

##### **GIS Coordinator**

(Goal 1: Objectives 1.3 and 1.4; Goal 2: Objectives 2.2 and 2.3; Goal 3: Objectives 3.2 and 3.3)

A dedicated GIS Coordinator is needed to access, develop and maintain maps necessary for land acquisition and protection; to fully implement NERR SWMP Phase III (Habitat Mapping and Change); and to provide illustrative mapping needed for education, outreach, and training.

##### **Web and Technology Coordinator**

(Goal 1: Objective 1.1; Goal 2: all objectives; Goal 3: Objectives 3.1, 3.2, 3.3 and 3.5)

Ten years ago (1998) at a meeting of scientists and government workers, Rob Magnien (then director of DNR's Tidewater Ecosystem Assessment) asked for a show of hands to see how many people had Internet Access. Less than half of the people raised their hands. Today almost everyone has Internet Access—at home, at work, at school, in their

pocket. A Web and Technology Coordinator is key to helping the Reserve reach students, teachers, citizens, and decision-makers effectively and efficiently using the Internet and other modern technology, such as iPod technology.

**Communications and Social Marketing Coordinator**

(Goal 1: Objective 1.1; Goal 2: all objectives; Goal 3: Objectives 3.1, 3.2, 3.3 and 3.5)

A Communications and Social Marketing Coordinator is needed to increase the visibility of the Reserve and to help translate sound science into behavior change. The Communications and Social Marketing Coordinator will develop a communication plan, develop outreach and training materials, and provide behavior change and communication expertise in developing education, outreach and training programs.



## **5. RESEARCH AND MONITORING**

### **5.1 Introduction**

A key goal of the National Estuarine Research Reserve System (NERRS or the System) is to “deliver relevant and timely information to support informed decision-making and increase public understanding of the importance of protecting estuarine and coastal habitats for future generations” (Owen and White 2005). The Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) contributes to this goal, as well as to the goals of the Maryland Department of Natural Resources (DNR).

NERRS provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the NERRS research and monitoring plan 2006-2011 which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries.

#### **5.1.1 National Estuarine Research Reserve System Goals**

Research within the reserves is designed to fulfill the NERRS goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, State, public and private use of one or more reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

#### **5.1.2 National Estuarine Research Reserve System Research and Monitoring Plan Goals**

NERRS research and monitoring goals are embedded in Goal Two of the NERRS *Strategic Plan 2005-2010*, “Increase the use of reserve science and sites to address priority coastal management issues,” and are outlined in the 2006-2011 NERRS Research and Monitoring Plan. They include:

- Biological, chemical, physical, and ecological conditions of reserves are characterized and monitored to describe reference conditions and to quantify change.
- Scientists conduct research at reserves that is relevant to coastal management needs and increases basic understanding of estuarine processes.

- Scientists have access to NERRS datasets, science products and results
- The scientific, coastal management and education communities, as well as the general public, use data, products tools, and techniques generated at the NERRS.

### **5.1.3 Maryland Department of Natural Resources Mission and Objectives**

CBNERR-MD will help achieve the Maryland Department of Natural Resources (DNR) mission key objectives and the goals of county management partners. The mission of DNR is to preserve, protect, enhance and restore Maryland's natural resources for the wise use and enjoyment of all citizens. Key objectives that the Reserve will help achieve are:

- Sustainable populations of living resources and aquatic habitat
- Healthy Maryland watershed lands, streams and non-tidal rivers
- Natural resources stewardship opportunities for Maryland's urban and rural citizens

### **5.1.4 Jug Bay Wetlands Sanctuary Research and Monitoring Mission and Objectives**

Jug Bay Wetlands Sanctuary (JBWS), which comprises the Anne Arundel County portion of the Jug Bay component, has its own research and monitoring mission and objectives, which support CBNERR-MD Goals Two and Three and are supported by CBNERR-MD programs.

Jug Bay Wetland Sanctuary's research and monitoring mission states that the Sanctuary will "conduct research and monitoring that teaches the public of all ages about natural history and wetland ecology." Research objectives are to:

- Investigate local environmental quality
- Investigate plant and animal ecology
- Study biogeochemical cycling and water quality in the Patuxent River and its wetlands

Studies will focus on relevant conservation issues and will be linked to ongoing local or national research and monitoring efforts whenever feasible.

#### Jug Bay Wetlands Sanctuary Advisory Committee

JBWS has a Science Advisory Committee (SAC) that helps to direct and target research projects within the Sanctuary. Its members represent key science departments at major universities as well as the Smithsonian Environmental Research Center (SERC). The Committee engages in several activities:

- Advises JBWS staff on its overall Research Program
- Reviews research proposals, reports, publications and abstracts for conferences
- Promotes JBWS as a field laboratory
- Provides expertise for selected projects

### **5.1.5 National Estuarine Research Reserve System Research Funding Priorities**

Federal regulations, 15 C.F.R. Part 921.50 (a), specify the purposes for which research funds are to be used to:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem,
- Provide information needed by Reserve Managers and coastal ecosystem policy-makers, and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

NERRS has identified the following five priority research areas to complement the funding priorities outlined above:

- Habitat and ecosystem processes
- Anthropogenic influences on estuaries
- Habitat conservation and restoration
- Species management
- Social science and economics

#### **5.1.6 National Estuarine Research Reserve System Research and Monitoring Programs**

Currently, there are two NERRS system-wide efforts to fund estuarine research and monitoring activities—the Graduate Research Fellowship Program (GRF) and the System-wide Monitoring Program (SWMP). In addition, National Estuarine Research Reserves cooperate with the Cooperative Institution for Coastal and Estuarine Environmental Technology (CICEET) and serve as test beds for tools that “detect, prevent, and reverse the impacts of coastal pollution and habitat degradation on coastal ecosystems and communities.”

##### Graduate Research Fellowship Program

The Graduate Research Fellowship Program supports students to conduct high quality research in the reserves. The fellowship provides graduate students with funding for one to three years to conduct their research, as well as an opportunity to assist with the Research and Monitoring Program at a reserve. Projects must address coastal management issues identified as having regional or national significance; relate them to the reserve system research focus areas; and be conducted at least partially within one or more designated reserve sites. Proposals must focus on the following areas:

- Eutrophication, effects of non-point source pollution and/or nutrient dynamics
- Habitat conservation and/or restoration
- Biodiversity and/or the effects of invasive species
- Mechanisms for sustaining resources within estuarine ecosystems
- Economic, sociological, and/or anthropological research applicable to estuarine ecosystem management

Students work with the Research Coordinator or Reserve Manager at the host reserve to develop a plan to participate in the reserve's research and/or monitoring program. Students are asked to provide up to 15 hours per week of research and/or monitoring assistance to the reserve; this effort may take place throughout the school year or may be concentrated during a specific season.

### System-wide Monitoring Program

It is the policy of CBNERR-MD to fully implement the System-wide Monitoring Plan initiated by ERD in 1989, and as outlined in the NERRS regulations and NERRS *Strategic Plan: 2005-2010*:

- Environmental Characterization, including studies necessary for inventory and comprehensive site descriptions
- Site Profile, to include a synthesis of data and information
- Implementation of the System-wide Monitoring Program

The System-wide Monitoring Program provides standardized data on national estuarine environmental water quality and weather trends while allowing the flexibility to assess coastal management issues of regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national reference sites. The program also takes a phased approach and focuses on three different ecosystem characteristics.

#### *Phase I: Abiotic Variables*

The monitoring program currently collects high resolution data (collected every 15 minutes) on pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Each reserve uses a set of automated instruments and weather stations to collect these data for submission to the Centralized Data Management Office (CDMO). At some of the CBNERR-MD stations the data are telemetered so that they are accessible in near-real time through both the Eyes on the Bay and CDMO web sites.

All SWMP abiotic data from all reserves are compiled electronically at the central data management "hub" CDMO, located at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. CDMO provides additional quality control for data and metadata and they compile and disseminate the data and summary statistics via the Internet (<http://cdmo.baruch.sc.edu>) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

#### *Phase II: Biotic Variables*

NERRS is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available. Ongoing programs at CBNERR-MD include bay grass (SAV) monitoring, emergent vegetation monitoring, fish larval monitoring, marsh bird monitoring, and herp monitoring.

*Phase III: Watershed and Land Use Classifications (i.e., Habitat Mapping and Change)*

This effort attempts to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element is to examine the links between watershed land use activities and coastal habitat quality.

*Implementation of the System-wide Monitoring Program (SWMP) at CBNERR-MD*

The CBNERR-MD Research Program aims to provide accurate and reliable baseline information useful in detecting changes over time and determining spatial heterogeneity of environments at each component. The NERR System-wide Monitoring Program's protocols are followed for weather and water quality monitoring. Additionally, efforts are made to standardize all monitoring protocols and approaches at all sites, both in the tidal and non-tidal waters, to allow for cross-site comparison and use at the State, regional and national level. Monitoring efforts are done in close cooperation with the DNR at the State level and NERRS at the national level.

The Reserve participates fully in Phase 1 (Abiotic Parameters) of SWMP, monitoring water quality and weather parameters for long-term change and short-term variability. In addition, CBNERR-MD served as a successful pilot site for GOES satellite telemetry as part of NERRS participation in the Integrated Ocean Observing System (IOOS). Water quality monitoring efforts remain a high priority due to its local, regional and national importance. Shallow water habitat monitoring to include submerged aquatic vegetation (bay grasses) and marsh vegetation is also a high priority at all CBNERR-MD components. Emphasis is placed on efforts to improve the knowledge of shallow water systems with particular attention given to tracking water quality useful to the EPA's Chesapeake Bay Program and their efforts to assess shallow water based on criteria for dissolved oxygen, water clarity, and chlorophyll a concentrations.

The CBNERR-MD Research Program includes a variety of biological monitoring studies beyond macrophytes, including macroinvertebrates (freshwater), shellfish, nekton, birds, reptiles, amphibians, and mammals. Studies related to climate change, subsidence, erosion, accretion, and sea level rise, and associated ecosystem responses, have become a heightened priority. Also, in the next five years, CBNERR-MD plans to complete land use characterization of the Reserve and its watershed.

Applied research activities that aim at meeting management needs are strongly encouraged. Efforts are made to find creative ways and develop partnerships that will help fund management driven research questions at the Reserve. Research activities that allow for educational outreach, volunteer involvement and stewardship are particularly important.

Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET)

Considerable research involving CBNERR-MD has been funded through the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), a partnership between NOAA and the University of New Hampshire (UNH). CICEET uses the capabilities of UNH, the private sector, academic and public research institutions throughout the U.S., as well as the 27 reserves in NERRS, to develop and apply new environmental technologies and techniques. CICEET has invested millions of dollars in coastal environmental technology projects in Maryland. A summary of projects funded through CICEET is provided in Table 3.

<b>Table 3. Summary of CICEET-Funded Projects In Maryland</b>
Development and application of a rapid and robust sensor to measure nitrogen species in the coastal atmosphere
Functional assessment of how accretionary biofilters affect sediment dynamics in tidal marshes
Development of a model to predict the effects that filter feeding bivalves have on underwater plant life in estuaries
Real time detection and identification of contaminant sources in coastal and estuarine waters
Engineering bioretention for treating runoff by filtering pollutants - exploring which soils and mulches are best for filtering different pollutants
Use of microbial community metabolism to monitor and assess salt marsh ecological function
Development and testing of Remote Access Satellite Sensor Link (RASSL), an affordable, data communications system that provides real-time, two-way communication using satellite technology with water-quality sensor platforms in the field
Development of community model for Chesapeake Bay
Reduction of microbial and chemical pollution of coastal waters using pulsed UV disinfection
Refinement of bacterial growth efficiency as an index of salt marsh function
Modeling the effects of changes in turbidity on light available for submerged aquatic vegetation
Development of treatment wetland technology for VOC-contaminated groundwater
Measurement system for localizing groundwater flows into an estuarine environment
Development of urban site sustainability tool
Development of land use planning models using multiple-model averaging to reduce uncertainty when using watershed models:
Development of a portable interface to view data and map water quality in the field and on the fly
Exploration of constructed wetlands as a way to treat chlorinated solvents
Development of technology to track ground water and support monitoring and remediation activities

## 5.2 Chesapeake Bay Context: Research and Monitoring

The Chesapeake Bay is the largest estuary in North America, and its watershed covers parts of six states (Virginia, Maryland, Pennsylvania, New York, Delaware, and West Virginia) and the District of Columbia. Because of the invaluable socio-economic and ecological importance of the Chesapeake Bay, the need to better understand this complex estuarine system, and the urgent need to keep it healthy, a wealth of scientific information has been generated through many years by many different research institutions including academia, county, State, and federal agencies, regional organizations, non-profit organizations, and organized community groups.

Currently, a major priority of Chesapeake Bay monitoring efforts relates to the restoration of the Bay's water quality and natural resources with a focus on meeting the requirements of the 2000 Chesapeake Bay Agreement (including reducing nutrient and sediment inputs to the Bay, increasing SAV acreage, restoring oyster populations, etc.) and delisting areas of the Chesapeake Bay from the 303(d) list of impaired waters. Long-term water quality monitoring efforts within the Bay are very intensive and are led mainly by the DNR in Maryland and by the Virginia Institute of Marine Science (VIMS) in Virginia. In Maryland, DNR's long-term Chesapeake Bay monitoring currently includes:

- Water quality monitoring (data available at [www.eyesonthebay.net](http://www.eyesonthebay.net))
  - 50 continuous monitoring stations (YSIs)
  - 7 water quality mapping areas (DATAFLOW)
  - 80 long-term (since 1985) grab sampling stations that include full suite of nutrients
  - Ecosystem processes monitoring (e.g., nutrient fluxes)
- Meteorological monitoring (data available at [www.eyesonthebay.net](http://www.eyesonthebay.net))
  - 3 weather stations
- Biomonitoring
  - Benthic monitoring (fixed station and random station grab sampling)
  - Phytoplankton monitoring (grab sampling)
  - submerged aquatic vegetation (including annual flyovers plus ground surveys)

CBNERR-MD Research and Monitoring Program contribute to DNR's overall Chesapeake Bay monitoring efforts to measure long-term change and short-term variability by supporting four of the 50 water quality continuous monitors, additional grab sampling stations, and two of the three meteorological stations. CBNERR-MD also provides SAV sampling support and supports site partners in conducting a variety of fauna monitoring programs at Otter Point Creek and Jug Bay. CBNERR-MD sites can be used in the broader Chesapeake Bay context as reference sites, for example to test restoration techniques and monitor success.

In addition to contributing to sampling efforts, CBNERR-MD works collaboratively with DNR's Tidewater Ecosystem Assessment group and others to provide analysis of CBNERR-MD and other Maryland monitoring data to answer specific management question. With Education, Stewardship, and Coastal Training Programs as well as a Research Program, CBNERR-MD is able to translate and disseminate research and

monitoring results as meaningful and relevant information to students, teachers, decision-makers, and the general public, as well as other scientists.

A new focus for CBNERR-MD is to examine climate change effects, specifically sea level impacts, on marshes at Jug Bay and Monie Bay. This research provides essential information needed to understand the implications of sea level rise on Maryland's marshes and estuaries. At a more local level, the Reserve Research and Monitoring Program will be playing an important role fulfilling research and monitoring needs and priorities identified for each of the components and adjacent watersheds.

Located in the Chesapeake Bay where a large array of programs and partners are underway provides unique opportunities as well as challenges. The success of the CBNERR-MD Research and Monitoring Program will depend on maintaining close communications with other institutions/entities conducting research and monitoring activities within the Chesapeake Bay to minimize duplication of effort, maximize collaboration, and leverage resources. In the next five years, the Reserve will forge stronger partnerships with other scientific research programs within the Chesapeake Bay area.

### **5.3 CBNERR-MD Management Issues**

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

CBNERR-MD is comprised of three separate components or sites—Otter Point Creek, Jug Bay, and Monie Bay. Otter Point Creek and Jug Bay are considered tidal freshwater environments, while Monie Bay is characterized as mesohaline. In an effort to characterize each of the Reserve components a site profile will be completed. This site profile will provide valuable background information for each component and will identify information gaps and needs. This comprehensive document will be a useful tool

to guide future Reserve research and monitoring activities while addressing current management needs within the Reserve and adjacent watersheds.

The Reserve Research and Monitoring Program will address the identified management issues by continuing ongoing research and monitoring and implementing new research and monitoring activities. Increased development, and its associated impacts, is one of the major concerns in Otter Point Creek and Jug Bay. The monitoring of water quality, SAV, emergent vegetation, and fish communities at these components will be some of the main activities that will be conducted. These efforts will provide baseline and continuous monitoring data that will help to identify changes on these communities through time. They will also be useful in guiding appropriate restoration and educational efforts.

At the Monie Bay component the impacts of climate change, particularly sea level rise, are of major concern. The Reserve's Research Program will start a monitoring effort at this site that will focus on marsh communities and surface elevation dynamics. These monitoring activities will provide necessary information about the status of the marsh community in this area with regard to climate change and will help to guide new research and monitoring projects.

Research and monitoring activities conducted at all sites to address current management needs will be implemented with the collaboration of Reserve partners including county, State, federal, academic institutions. For example, at Otter Point Creek, the recently created Bush River Partnership, through a research and monitoring workgroup, will support research efforts in the area that will address current management needs. The research and monitoring strategies that will be considered to address current management needs and information gaps within each Reserve component are detailed below.

#### **5.4. CBNERR-MD Research and Monitoring Goals, Objectives, and Strategies**

The research and monitoring plan for CBNERR-MD is designed to address the mission and goals of the Reserve. The Reserve's mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The following is a set of objectives and strategies that drive the Research and Monitoring Program and support Reserve Goals One, Two, and Three. The Research Coordinator has primary responsibility for implementing these strategies, working closely with Research Assistants, Interns, Graduate Research Fellows, site staff, and other DNR staff.

### **GOAL 2. Increase the use of science and Reserve sites to address management issues.**

#### **Objective 2.1. More scientists will conduct estuarine research at the Reserve.**

Strategy: Increase the visibility and credibility of NERRS and CBNERR-MD within the Chesapeake Bay research community and within key scientific professional communities.

- Join key scientific associations (e.g., Estuarine Research Federation, Society of

Wetland Scientists, and Ecological Society of America).

- Participate in, present at, and contribute materials or posters for key scientific meetings (e.g., Estuarine Research Federation, Ecological Society of America, American Fisheries Society, American Society of Limnologists and Oceanographers, and/or Restore America's Estuaries).
- Make presentations at local universities to solicit interest and increase visibility within the academic community (e.g., University of Maryland, Salisbury State University, Towson State University, Morgan State University, Smithsonian Institution, Harford County Community College) and environmental labs (e.g., Horn Point Laboratory, Chesapeake Biological Laboratory, Morgan State University Estuarine Research Center at Jefferson Patterson Park, University of Maryland Eastern Shore Coastal Ecology Teaching and Research Laboratory). Promote the Reserve components as field laboratories focused on ecological assessments and evaluations of natural and anthropogenic impacts. Also promote the Reserve as part of a broader "NERRS reference site concept" to encourage monitoring and restoration activities by federal, State and local Research and Monitoring Programs.
- Facilitate and encourage the analysis, synthesis, publication, and dissemination of Reserve research and monitoring data (including GRF and Reserve intern projects) in peer-reviewed journals and/or web-published reports.
- Prepare a CBNERR-MD compendium of previous research conducted within the Reserve as a baseline for future studies.
- Use the Reserve web page to disseminate Reserve information to scientists and others. Develop, maintain, and disseminate the Reserve's research priorities and needs. Make available Reserve research compendium, site profiles (when available), management plan, research reports and publications, reserve-wide protocols, SWMP and other research data, and other relevant materials that may encourage and assist with the development of research projects.
- Provide opportunities for seeing and learning about research and monitoring activities through site tours for researchers and students.
- Work with Site Managers to coordinate and/or initiate Scientific Advisory Committees.
- Continue to implement the NOAA/NERRS Graduate Research Fellowship Program. Work to increase student applications to the CBNERR-MD GRFs, including minority students, by advertising and promoting the fellowship slots broadly, and ensuring that minority-serving institutions are contacted regarding fellowship openings.

Strategy: Initiate, promote, and nurture collaborations and partnerships with outside scientists, scientific programs, education institutions and other organizations that address Reserve goals.

- Investigate and pursue as appropriate working partnerships and joint proposals with key institutions (e.g., University of Maryland, Smithsonian Environmental Research Center, Morgan State University, Salisbury State University) to encourage research and monitoring activities at the Reserve components. Work with these institutions to tailor research activities that address Reserve goals and management needs.
- Actively facilitate use of the Reserve components as a location for scientific research by university faculty, graduate and undergraduate students (outside the GRF program), and volunteers.

- Continue partnerships and collaborations with other groups at DNR (e.g., Fisheries, Resource Assessment Service) for research projects and products.
- Continue partnership with NOAA National Geodetic Survey regarding marsh surface elevation research (e.g., installation of Surface Elevation Tables—SETs).
- Pursue partnership with NOAA’s Center for Operational Oceanographic Products and Services (CO-OPS) to acquire a vertically-controlled tide gauge at Jug Bay.

Strategy: Seek financial support for relevant and useful on-site research and monitoring activities conducted at the Reserve components that supports CBNERR-MD goals.

- Submit proposals soliciting financial support to conduct scientific projects that address priority research questions within the Reserve.
- Leverage funds for research through grants and partnerships with other research programs and/or institutions.

**Objective 2.2. Scientists, resource managers, and the general public will have access to NERRS and CBNERR-MD datasets and science products, and the Chesapeake Bay scientific community will use data, tools and techniques generated through NERRS and CBNERR-MD.**

Strategy: Make available Reserve research compendium, site profiles (when available), management plan, research reports and publications, SWMP and other research and monitoring data, and other relevant materials that may be useful to scientists, resource managers, and the general public.

Strategy: Continue to ensure that weather and water quality data are available for all SWMP stations on both the NERRS Centralized Data Management Office and Eyes on the Bay web pages.

Strategy: Work with CDMO, the Mid-Atlantic Coastal and Ocean Regional Association (MACOORA), IOOS and other regional and national efforts to ensure that data are interoperable with other datasets and to increase data usership.

Strategy: Work with Tidewater Ecosystem Assessment and DNR web managers to streamline data management to make all data available and accessible via the Internet in a timely manner (including for example, non-SWMP stations’ extractive chlorophyll data).

Strategy: Create interoperable datasets of archived Reserve research results and make the data available through the Reserve web site using latest data technology (e.g., xml). (ten-year plan)

Strategy: Standardize approaches, protocols, and data management across Reserve components and with other research efforts (e.g., NERRS, DNR, other federal and State agencies, MACOORA, IOOS, etc.) when and where applicable to facilitate research and data interoperability, data analysis, and data sharing.

**Objective 2.3. Scientists, professors, and undergraduate and graduate students will have an increased ecological understanding of estuaries and an increased understanding of the relationships among estuaries and human activities, social**

## **issues, values, and behaviors through CBNERR-MD research and monitoring.**

Strategy: Continually identify information gaps and priorities needed to understand the Reserve ecosystems and address management issues, to understand the relationship between anthropogenic and natural stressors and the Reserve ecosystems, and to answer management questions.

Strategy: Design, conduct, and coordinate research projects that fill information gaps and increase the understanding of ecosystem dynamics and functioning at the Reserve and the understanding of the interactions between anthropogenic and natural stressors and the Reserve ecosystems.

Strategy: Assess and monitor short term variability and long term changes in estuarine habitats and communities within the three components of the Reserve by fully implementing Phase I of the System-wide Monitoring Program as described in the SWMP protocols.

- Continue to ensure that the Reserve is collecting accurate SWMP Phase I water quality and weather data and submitting the data to the Central Data Management Office on time.
- Integrate SWMP Phase I continuous water quality monitoring with on-going water quality monitoring efforts at each component for better spatial resolution and to tie in with Maryland Eyes on the Bay and the Virginia Estuarine and Coastal Observing System (VECOS) continuous monitoring throughout the Chesapeake Bay.

Strategy: Establish new, and continue and/or expand ongoing, abiotic monitoring programs for the collection of baseline data useful in detecting trends and changes over time that address identified management issues. For example, establish water quality monitoring in tidal habitats (and non-tidal habitats when applicable) at Otter Point Creek, Jug Bay, and Monie Bay.

Strategy: Conduct sediment dynamics studies, including surface elevation change and sediment particle size, and/or nutrient concentrations at the three Reserve components to establish baseline data.

Strategy: Establish biological monitoring projects including SWMP Phase II projects. Include submerged aquatic vegetation, emergent aquatic vegetation, marsh birds, nekton, and benthic macroinvertebrate communities in tidal (and non-tidal when applicable) habitats.

Strategy: Continue to provide staff and intern time to support and expand on-going site biomonitoring of plankton, reptiles, amphibians, birds, and mammals. Help standardize protocols across sites and with other larger research efforts.

Strategy: Implement Phase 3 of SWMP by assessing and monitoring land use and habitat change and restoration success at the Reserve through GIS tools.

- Develop an inventory of maps and GIS products of the Reserve, including links to other available related resources, and make this available on the Reserve web page.
- Develop a list of GIS priorities at the three Reserve components and a strategy to

address those needs.

- Continue partnerships with DNR GIS group, NOAA, USGS and others to leverage GIS expertise and resources to address priority GIS needs within the Reserve.
- Build Reserve staff capacity and equipment to support a basic GIS program that addresses main GIS priorities at the Reserve.
- Develop a strategy to seek additional resources and upper management support to support Reserve GIS capabilities.

Strategy: Complete site profiles at all Reserve components. The site profile is a synthesis of environmental information, which combines literature searches and field research to provide a characterization of the Reserve in terms of its resources, issues, management constraints, and research needs.

Strategy: Conduct appropriate research and monitoring that will support and evaluate the success of environmentally-friendly techniques in local development projects.

Strategy: Promote social science research that addresses both environmental and human issues.

**Objective 2.4. The CBNERR-MD Research Program will have increased governmental and community support.**

Strategy: Participate in or present information to relevant federal, State, or local agencies, committees, and workgroups (e.g., Chesapeake Bay Observing System, Maryland Sea Grant, EPA Chesapeake Bay Program Monitoring and Analysis Subcommittee, Mid-Atlantic Coastal and Ocean Observing Regional Association).

Strategy: Foster collaborations with the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET).

- Work with NOAA and CICEET staff to facilitate the use of sites within the Reserve to further the development of new technologies to understand and address the impacts of coastal and estuarine contamination and degradation. Many CICEET funded projects have been conducted in Maryland as summarized in Table 3 (Also see [www.ciceet/unh.edu](http://www.ciceet/unh.edu)).
- Improve communication and participate as appropriate in CICEET planning processes to ensure that local concerns and issues are being considered.

Strategy: Where appropriate, incorporate research volunteers from the local community to help with data collection, management, and analysis, while building community support and ownership.

**GOAL 3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.**

**Objective 3.1. Students and teachers will have an increased estuarine and environmental literacy.**

Strategy: Coordinate with the Reserve's Education Coordinator and Site Managers and staff to appropriately translate and disseminate estuarine science research information for K-12 students and teachers.

Strategy: Work closely with Reserve and site staff and others to ensure that the research questions are being asked that are providing information sought by teachers and students and that research is being conducted that can be translated to educational programming/outreach efforts.

**Objective 3.2. Maryland's urban and rural citizens will have an increased understanding of the ecological, economic, historical and cultural importance of estuarine and coastal resources and how human choices and natural disturbances impact social, economic and estuarine ecological systems.**

Strategy: Coordinate with the Education Coordinator and Site Managers and staff to appropriately translate and disseminate estuarine science research information for the general public.

Strategy: Engage local citizens as volunteers in research and monitoring projects so they can learn first-hand the importance of estuarine systems and how human choices and natural disturbances impact these environments, while fostering a sense of stewardship in the broader community.

Strategy: Coordinate with the Reserve's Stewardship Coordinator and Site Managers and staff to appropriately translate and disseminate research information to volunteers.

Strategy: Coordinate with Reserve and site staff and others to ensure that research questions are being asked that are providing information sought by the general public and that research is being conducted that can incorporate volunteers as appropriate.

**Objective 3.3. Coastal decision-makers will receive knowledge, information, and skills to improve coastal management.**

Strategy: Coordinate with Reserve and site staff and others to ensure that the research questions being asked are providing information sought by decision-makers.

Strategy: The Research Coordinator will coordinate with the Coastal Training Program Coordinator and Site Managers and staff to appropriately translate and disseminate research information for decision-makers and stakeholders. For example,

- Organize and synthesize (as appropriate) existing information on the Reserve and its watershed and on research conducted in or by the Reserve to address priority management issues.
- Summarize SWMP data and other research data for the Site Managers, EC, SC, CTP and others and suggest how these data may be applied toward providing solutions to particular management problems.

Strategy: Work in collaboration with the Reserve's Coastal Training Program to develop

targeted workshops promoting the understanding and use of scientific information, and the formulation of research activities to address management issues within the Chesapeake Bay.

**Objective 3.4. Coastal decision-makers will use science-based information in making decisions that will affect coastal and estuarine resources.**

Strategy: Work with other Reserve staff and others to facilitate the transfer of research information to the management community at a local, State and regional level in a manner that responds to the needs of the decision-makers and allows for easy and immediate use.

**5.5 Research and Monitoring Efforts at the CBNERR-MD**

Priority research and monitoring activities for each of the Reserve components—Otter Point Creek, Jug Bay, and Monie Bay—have been identified and summarized in Appendix J. These activities have been designed to accomplish in the short and long-term the goals and objectives specified in this research and monitoring plan, and will entail the necessary coordination and collaboration with existing and new partners (see section 5.6).

In addition to working with partners, the Reserve Research Program will actively engage with academic and other research institutions (i.e., through presentations and local visits) to foment their interest in conducting projects that will address research needs within the Reserve. Volunteers have always played an important role in the collection of field data, particularly as part of monitoring projects. This relationship could be strengthened by providing more opportunities for training, direct involvement with the planning, collection, and analysis of data, and delivery of information to appropriate audiences.

In an effort to increase available resources to conduct research within the Reserve and adjacent watersheds, the Research program will pursue available grants in collaboration with partners. The NERRS Graduate Research Fellowship program will continue to provide additional opportunities to address research needs within the Reserve.

**5.5.1 Otter Point Creek**

Specific research and monitoring activities at Otter Point Creek will be directed at assessing the current ecological State of the natural resources in this component as well as monitoring changes over time. For this purpose the Reserve Research Program will implement initial efforts to obtain baseline information and long-term monitoring data of SAV and emergent vegetation communities. A similar effort will be pursued for riparian and terrestrial areas through collaborations and as resources become available. This type of monitoring, in addition to the ongoing water quality monitoring, is important to detect changes in the component's natural resources due mainly to development and land use changes. In a broader scale, the use of GIS will be vital for determining the impact of development and land use changes on these natural systems, and it will be implemented as possible with the support of partners (i.e., the GIS group at DNR and Towson University).

In an effort to address many of the issues currently affecting Otter Point Creek, adjacent watersheds, and the Bush River in general, a Bush River Partnership involving Reserve staff and local and State partners has been recently formed. As part of this partnership, a research and monitoring workgroup is working to identify research needs and priorities as well as effective ways to fulfill those needs. This effort started in 2007 and it is expected to grow as more partners are identified and join the effort.

### **5.5.2 Jug Bay**

Specific research and monitoring activities at Jug Bay will be directed at assessing the current ecological State of Jug Bay's natural resources as well as changes over time due to the impact of land use and land use changes, management decisions and restoration activities, and climate change, particularly sea level rise. Additional efforts will focus on identifying point and non-point sources of pollution and their impacts on water quality and natural resources. The current approaches to address these issues is the continuation of in-place monitoring projects, including water quality, SAV, emergent vegetation, and marsh surface elevation dynamics monitoring. Expansion of monitoring efforts will be considered to involve riparian and terrestrial habitats and to include new sampling sites within impacted watersheds as necessary and as resources become available. New research projects will be targeted to address specific questions and information gaps as identified in Appendix J.

Along with continuing and implementing new research and monitoring projects, a new effort will focus in the analysis of long-term existing data (i.e., water quality, vegetation and fauna surveys, etc). This data analysis will be designed to answer specific questions and it will be conducted as possible with collaboration with experts on specific issues. Similarly to Otter Point Creek, GIS tools will be used to analyze larger scale habitat changes due to land use. Additionally, GIS will be employed as a means to analyze success of restoration efforts in Jug Bay, particularly wild rice restoration.

Jug Bay is the only component of the Reserve that has a Science Advisory Committee. This Committee has been an important resource for the review of research and monitoring proposals and to identify research needs. The following research topics have been specifically endorsed for Jug Bay Wetlands Sanctuary (JBWS) by the JBWS Science Advisory Committee; these complement CBNERR-MD Goal Two (Increase the use of science and Reserve sites to address management issues):

- Patterns of tidal wetlands use by eastern box turtles
- Spotted turtle home range and nesting behavior
- Use of shrub-scrub habitat by migratory songbirds
- Phosphorus dynamics along an estuarine gradient
- West Nile virus in migratory songbirds
- Effect of salinity on carbon metabolism
- Groundwater hydrology and denitrification pathways in a tidal freshwater marsh
- Behavior of wintering gulls in Jug Bay
- Diet determination of red bellied turtles

- Water quality monitoring of Galloway, Pindell, and Two-Run creeks
- Water quality and nutrient dynamics in a freshwater tidal wetland

### **5.5.3 Monie Bay**

Specific research and monitoring activities at Monie Bay will be directed at assessing the current ecological State of the component's natural resources and monitor any potential changes due to development and climate change, particularly sea level rise. Currently, water quality and wildlife monitoring are the main efforts in place and water quality monitoring will continue as part of the Reserve's SWMP effort. New projects regarding monitoring of emergent vegetation and surface elevation dynamics will be initiated in an effort to monitor potential impacts to this area as a result to climate change, development, and land use changes. Other research and monitoring needs as outlined in Appendix J will be pursued as possible in collaboration with local academic institutions as well as other research institutions.

### **5.6 Key Partners**

The Chesapeake Bay is a complex ecosystem that encompasses different State and county jurisdictions, and includes a large number of local, State, and federal programs working on a wide range of research, restoration, and education programs. Because of this, appropriate coordination and collaboration is fundamental to maximize resources while addressing Chesapeake Bay's needs and priorities. Following is a list of primary partners to the Reserve Research and Monitoring Program.

#### **Otter Point Creek**

Research projects should be coordinated closely with the following partners:

- Other groups within DNR (e.g., Resource Assessment Service, Fisheries)
- Harford County local government (Division of Parks and Recreation, Division of Planning and Directorate of Public Works)
- Otter Point Creek Alliance
- US Army Environmental Center
- US Army Aberdeen Proving Ground

In addition, research partnerships should be pursued with nearby institutions including:

- University of Maryland at Baltimore, College Park, and Baltimore County
- Johns Hopkins University
- Towson State University
- Morgan State University
- Harford Community College

#### **Jug Bay**

The Jug Bay Wetlands Sanctuary and Patuxent River Park' staff jointly manage the Jug Bay Component. All research and monitoring efforts should be coordinated closely with the following entities:

- Other groups within DNR (e.g., Resource Assessment Service, Fisheries)
- Anne Arundel County

- Maryland- National Capital Park and Planning Commission
- Friends of Jug Bay
- The US Fish and Wildlife Service's (USFWS) Patuxent Research Refuge and National Wildlife Center

Research efforts and activities should be pursued with nearby institutions including:

- University of Maryland at College Park
- University of Maryland Center for Environmental Science - Chesapeake Biological Laboratory Bowie State University
- Anne Arundel Community College
- Prince George's Community College

Due to the proximity of the component to the Washington D.C. area, coordinating efforts should be encouraged with the following institutions:

- George Washington University
- Georgetown University
- University of the District of Columbia
- Howard University

### **Monie Bay**

Similarly to the other two components, all activities should be coordinated with other groups within DNR. But, because of the remoteness of the site, research efforts and activities should be pursued with nearby institutions including:

- University of Maryland's Center for Environmental Science-Horn Point Laboratory
- University of Maryland Eastern Shore
- Salisbury State University

Efforts should also be made to coordinate with Somerset County and US Fish and Wildlife Service (USFWS).

## **5.7 Future Direction**

The overall CBNERR-MD's Research and Monitoring Program is driven partly by the national SWMP efforts and partly by the research and monitoring needs and priorities identified at the three Reserve components. As outlined in previous chapters of this plan, the main local issues facing CBNERR-MD are related to potential impacts due to development and/or climate change. Most research and monitoring efforts to be conducted within the Reserve will be prioritized based on these main issues.

SWMP Phase I (water quality and weather monitoring) has been fully implemented and will continue at the three sites according to NERRS protocols. This effort has been expanded locally by increasing the number of water quality sampling stations at each of the three Reserve sites, and it will continue in an effort to better monitor spatial and temporal water quality variability and change. The implementation of SWMP Phase II (biomonitoring) is not fully in place in any of the components, but constitutes a main priority for the Research Program and the Reserve. Initial efforts will be focused to implement monitoring of SAV and emergent vegetation at Otter Point Creek and Jug

Bay, and emergent vegetation at Monie Bay. These will follow, as possible, protocols defined by NERRS.

The implementation of SWMP Phase III (Habitat Classification and Change) is in preliminary stages. Basic mapping and habitat classification for the Reserve have been completed, but additional work remains to be done to estimate habitat change due to land use and development and to evaluate success of ongoing restoration efforts (i.e., wild rice restoration in Jug Bay). A full implementation of SWMP Phase III will require building CBNERR-MD GIS capabilities, including specialized GIS staff and acquisition of necessary software and hardware. As long as this capability is not in place, efforts on this area will highly depend on collaboration with partners, particularly the GIS group within DNR.

Monitoring projects outside SWMP currently being implemented at Otter Point Creek and Jug Bay are mainly supported by volunteers. These are a fundamental part of the monitoring program and the Reserve will continue to support them. Similar efforts will be pursued for Monie Bay.

In an effort to foment research within the Reserve, the CBNERR-MD Research Program will foster collaborations with academic and other research institutions. Currently, laboratories and other infrastructure available at Otter Point Creek and Jug Bay offer resources to scientists and students. The Reserve will be pursuing the construction of a research/education facility at Monie Bay that will facilitate these types of collaborations. Similarly to Jug Bay, Otter Point Creek and Monie Bay will benefit from the establishment of Science Advisory Committees, which members will include scientists and resource managers from local institutions.

Along with data collection, an approach to increase the analysis of existing information will be a major priority for the CBNERR-MD Research and Monitoring Program. This approach will support the need to increase the use and transfer of information to the scientific community, resource managers, and other potential users. As possible, efforts will also be undertaken, in coordination with NERRS as appropriate, to manipulate and use existing monitoring and research data in the development and implementation of educational programs for the K-12 audience as well as science teachers.



## 6. EDUCATION AND INTERPRETATION

### 6.1 Introduction

An effective and coordinated Education Program is needed to achieve the goals of the National Estuarine Research Reserve System (NERRS) as a whole, as well as the goals of the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) and the Maryland Department of Natural Resources (DNR).

NERRS provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation in the reserves incorporates a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues and incorporate science-based content. Reserve staff members work with local communities and regional groups to address coastal resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education programs, the reserves help communities develop strategies to deal successfully with these coastal resource issues.

Formal and non-formal education and training programs in the NERRS target K-12 students, teachers, university and college students and faculty, as well as coastal decision-maker audiences such as environmental groups, professionals involved in coastal resource management, municipal and county zoning boards, planners, elected officials, landscapers, eco-tour operators and professional associations.

K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with State and national science education standards and frequently involves both on-site and in-school follow-up activity. Reserve education activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. Education and training programs, interpretive exhibits and community outreach programs integrate elements of NERRS science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

The CBNERR-MD is an important vehicle for increasing understanding and awareness of the Chesapeake Bay as a vital and productive albeit challenged estuarine system. The education, training and outreach programs that have been developed, implemented and/or supported by the Reserve have helped various communities take action based on that increased understanding and awareness. Members of various educational, decision maker and public communities have participated in Reserve educational programming and learned about such topics as submerged aquatic vegetation and efforts to restore it, the impact of septic systems on the habitat and water quality of the Bay as well as many other topics relevant to the Reserve. All educational opportunities strive to integrate research with educational and outreach programming.

### **6.1.2 National Estuarine Research Reserve System Education Goals**

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. The Education program in the Reserve is designed to fulfill the reserve system goals as defined in the regulations (15 CFR Part 921(b)):

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation; and,
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

### **6.1.3 National Estuarine Research Reserve System Education Objectives**

The National Estuarine Research Reserve System goals are supported on a national level through the Reserve System's strategic plan (2005-2010). The Reserve's education programs are designed to support the following goal and objectives outlined in the strategic plan.

Ø **NERR Strategic Goal 3:** Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

#### **Objectives**

- People are aware of the ecological, economic, historical, and cultural importance of estuarine resources
- People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems.
- People apply science-based information when making decisions that could impact coastal and estuarine resources.

The Reserve utilizes both formal and informal education to implement the relevant actions in support of the Reserve's goals and objectives. Formal education programs for various audiences ranging from students to the general public are conducted at all of the components. These programs are a mixture of classroom and field activities planned and organized in partnership with the participating group, the component education team and Reserve staff. The informal education occurs as a result of the general public's visitation at the Reserve. Both the Jug Bay and Otter Point Creek components interpret the Reserve, estuaries, and research as well as the Chesapeake Bay through interactive exhibits in the visitor centers.

In general, the Education Coordinator works on two distinct types of formal education programs: component specific programs and Reserve programs. The Reserve programs

are standardized across the components and focus on estuarine issues, particularly issues that are relevant to CBNERR-MD research and monitoring. Component specific programs address local issues that are of particular interest to the reserve site, applicable to the regional environmental conditions, and take advantage of the special features of the individual component. For example, at the Jug Bay component, wild rice, its ecological value and the ways in which it is impacted by both natural and anthropogenic factors is regularly addressed through this site's educational programming.

## **6.2 Chesapeake Bay Context: Education**

The Reserve is situated in the Mid-Atlantic region among a wealth of environmental educational and interpretative programs developed to inform the public and meet the needs of National organizations based in Washington DC, the Chesapeake Bay Programs, State and local governments, and private nonprofit groups. In addition, three of the four counties where the Reserve is located have environmental education centers associated with the county school systems:

- Harford County – Harford Glen
- Prince George's County - Schmidt Outdoor Education Center
- Anne Arundel County – Arlington Echo

Many of these programs and centers have the potential to benefit the mission of the Reserve as well as compete with the Reserve's programs for the attention of local as well as regional audience.

During the life of the Reserve, its education and interpretation programs have tended to be developed to meet or augment local needs and interests. This history has yielded education and interpretation programs, developed in cooperation with (and reliance on) site management and local partners, which differ at each Reserve component. At the same time, the Reserve has worked to incorporate national program themes at each site and to transfer successful programming ideas, materials, and approaches among the Reserve components.

In addition to supporting ongoing site education programs, CBNERR-MD is working to focus programmatic offerings on the use of CBNERR-MD and NERRS research, authentic data, and curriculum. This opportunity is enhanced by the 2000 Chesapeake Bay Agreement. This agreement, between the governors of Pennsylvania, Maryland, Virginia, and the Mayor of the District of Columbia, the EPA and the Chesapeake Bay Program, requires that all students participate in meaningful Bay education experiences. A meaningful bay education experience must include rigorous academic learning standards, promote a sense of wonder, and nurture a sense of community that will connect students to the Bay and move them to take action toward its protection and restoration.

Overall at CBNERR-MD, education programs have increased in volume to serve over 2,800 K-12 students with over 140 education programs in the last recent grant period (October 1, 2006 to September 30, 2007). The focus for the next five years will be to increase the number of programs at Monie Bay, raise the bar on the academic quality of

education programs, tie programs more closely to State education standards, and use authentic data and student-derived questions in more programs.

The Reserve has a unique opportunity to draw on estuarine education programs and curricula developed throughout the country at the other 27 estuarine reserves and at the national level. Reserve staff can capitalize on these estuarine education products and work directly with State education efforts, county school systems, schools, and teachers, to help bring meaningful bay experiences and rigorous estuarine education to Maryland students.

The success of the CBNERR-MD education program will depend on maintaining close communications with schools, environmental education centers, and environmental education programs in Maryland to minimize duplication of effort, maximize collaboration, and leverage resources. CBNERR-MD will continue to stay involved with professional associations such as the Maryland Association for Environmental and Outdoor Education (MAEOE).

### **6.3 CBNERR-MD Management Issues**

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels. These management issues are the primary drivers of the subject matter communicated through the educational programming.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

Underlying all of the educational programming in the Reserve will be the fundamental management issues of population growth and its impacts on land use as well as the multitude of issues related to climate change. These management issues will be explored through K-12 student programming that uses the Reserve components as field laboratories and incorporates the use of SWMP data as part of the classroom curriculum, such as those activities found in Estuaries 101. Teachers will have opportunities to

participate in professional development programs geared toward developing their understanding of these issues and the resources available to them for communicating that understanding to their students. Education programs for the general public will also be developed with these issues as a consistent theme.

#### **6.4 CBNERR-MD Education Goals, Objectives, and Strategies**

Effective education and outreach is key to fulfilling the CBNERR-MD mission. The Reserve's mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The following are a set of objectives and strategies identified as part of the Reserve education program, for which the Reserve Education Coordinator has primary responsibility, working together with site staff and other CBNERR-MD DNR staff. Reserve goals are linked to and supported by the Reserve Education Program. These objectives and strategies support goals one, two and three.

#### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

##### **Objective 1.1. Reserve operations will be improved by ensuring adequate State support, maintaining local support capabilities, and fostering good internal communication.**

Strategy: Increase the visibility of the Reserve within State and local agencies and organizations and with the general public.

- Conduct tours of each component for resource managers from local, State and federal agencies, county school officials, and local business associations.
- Publish articles authored by the Reserve in the newsletters of Jug Bay Wetlands Sanctuary and Otter Point Creek.
- Maintain and update the Reserve web-site.
- Publish an annual report highlighting major accomplishments of the Reserve.
- Encourage reserve related articles in regional Chesapeake Bay publications.
- Develop partnerships with other regional environmental education providers and industry associations.
- Attend meetings and make presentations on both CBNERR-MD and NERRS education efforts.
- Communicate regularly with other sectors (Research, Stewardship, and Coastal Training Program) and among sites.

##### **Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Maintain and build appropriate educational facilities, infrastructure, and

interpretive displays.

- Acquire appropriate suitable property and prepare plans to develop Research/Education/Cultural Visitor Center, research station, and associated out-buildings at Monie Bay.
- Maintain and augment nature trails and boardwalks at Otter Point Creek and Jug Bay.
- Design and build nature trails and boardwalks at Monie Bay.
- Provide interpretive information (including signs and exhibits) on relationships between human activities and estuarine ecosystems focusing on climate change and population growth/development patterns.

Strategy: Survey needs of local seniors and Maryland School for the Blind and other relevant organizations, and explore opportunities at Otter Point Creek site for improving portion of trail and interpretive devices to accommodate mobility-impaired and visually-impaired visitors.

## **GOAL 2. Increase the use of science and Reserve sites to address management issues.**

### **Objective 2.4. The CBNERR-MD Research Program will have increased governmental and community support.**

Strategy: Enhance outreach and partnership activities. Form new partnerships with individuals and groups whose interests overlap those of the Reserve.

- Develop closer ties with Maryland Sea Grant, NOAA Chesapeake Bay Office in Annapolis, EPA Chesapeake Bay Program Office, Chesapeake Bay Foundation, Morgan State University and the University of Maryland Eastern Shore.
- Develop or enhance relationships with community colleges in jurisdictions with the Reserve components/sites.
- Develop relationship with Morgan State University through Environmental Cooperative Science Center (ECSC) program.

## **GOAL 3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.**

### **Objective 3.1. Students and teachers will have an increased estuarine and environmental literacy.**

Strategy: Provide education programs where students and teachers develop real-life estuarine resource management questions and answer them using authentic estuarine science data.

Strategy: Work with schools to help them provide "meaningful bay experiences" for students. A meaningful bay experience must include rigorous academic learning standards, promote a sense of wonder, and nurture a sense of community that will connect students to the Bay and move them to take action toward its protection and restoration.

Strategy: Work with schools to help them implement estuarine and environmental science curricula.

Strategy: Conduct needs assessment of educators in Harford, Prince George's, Anne Arundel and Somerset Counties (and neighboring counties when appropriate) to determine how CBNERR-MD can most effectively help educators improve estuarine and environmental literacy.

Strategy: Implement the NERRS K-12 Estuarine Education Program (KEEP) at the Reserve. KEEP incorporates technology and web-based learning, experiential learning, and teacher training. KEEP is tied to education standards and includes ongoing evaluations to track the success of the program.

- Work with Research Coordinator and ERD to improve access to CBNERR-MD and NERRS-wide data. Use these data where appropriate in education programs.
- Pursue the use of new technologies in education programs, such as iPod technology.
- Develop and implement teacher professional development opportunities that utilize KEEP, Estuaries 101, and other NERRS programs and products (such as curricula).

Strategy: Increase effective education to underserved populations. Work to advertise and recruit more ethnically and socio-economically diverse participation in all programs.

Strategy: Work with the Chesapeake Bay Program (both NOAA and EPA offices), the Maryland Coastal Bays Program and others to promote Estuaries Day and Estuaries Live.

Strategy: Develop partnerships to expand audience and to leverage resources.

- Participate in DNR's Education Matrix team.
- Develop relationship with Morgan State University through Environmental Cooperative Science Center (ECSC) program.
- Augment relationships with county schools.
- Initiate relationships with informal education programs (e.g., National Aquarium in Baltimore, Salisbury Zoo).
- Foster relationships with relevant non-profits (e.g., Chesapeake Bay Foundation).

Strategy: Increase the visibility and credibility of NERRS and CBNERR-MD within the Chesapeake Bay education community and within key professional communities.

- Participate in regional, State and local events (e.g., Maryland State Fair, National Estuaries Day, Wade-Ins, etc.) to promote the Reserve, its components and DNR.
- Participate in meetings with key professional educator groups (e.g., Maryland Association for Environmental and Outdoor Education, DNR's Education Matrix Team).
- Continue active participation in NERRS education activities (e.g., Estuaries 101).

Strategy: Coordinate with the Research Coordinator and Site Managers and staff to appropriately translate and disseminate estuarine science research information for K-12 students and teachers.

Strategy: Coordinate with the Research Coordinator, CDMO, and DNR Tidewater Ecosystem Assessment (oversees EyesontheBay monitoring) to make research and monitoring data available in user-friendly formats for teachers and students.

Strategy: Work closely with the Research Coordinator, the Stewardship Coordinator, and site staff to ensure that CBNERR-MD research is investigating questions of significance to teachers and students and relevant to curricula.

Strategy: Evaluate programs to determine effectiveness.

**Objective 3.2. Maryland's urban and rural citizens will have an increased understanding of the ecological, economic, historical and cultural importance of estuarine and coastal resources and how human choices and natural disturbances impact social, economic and estuarine ecological systems.**

Strategy: Continue to develop and implement new and updated public educational programs that improve awareness and build community-level support for estuarine and coastal stewardship and encourage Marylanders to make personal choices that reduce their impact on Chesapeake Bay and its tributaries.

Strategy: Complement existing education programs with additional community education opportunities, including targeting underserved populations.

Strategy: Build and maintain educational facilities and interpretive displays.

Strategy: Coordinate with Research Coordinator and others to ensure that the research questions being asked are providing information sought by the general public.

Strategy: Coordinate with the Research Coordinator and Site Managers and staff to appropriately translate and disseminate estuarine science research information for the general public.

Strategy: Evaluate programs to determine effectiveness.

**Objective 3.4. Coastal decision-makers will use science-based information in making decisions that will affect coastal and estuarine resources.**

Strategy: Provide meaningful bay experiences for the public and decision-makers to inspire interest in changing behavior to protect coastal and estuarine resources. A meaningful bay experience promote a sense of wonder and nurture a sense of community that will connect participants to the Bay and move them to take action toward its protection and restoration.

Strategy: Work together with Manager, Research Coordinator, Stewardship Coordinator, Coastal Training Program Coordinator, site staff, and DNR and NOAA Communications staff to make scientific information available and accessible through the web page, presentations, workshops, trainings, and other means.

Strategy: Evaluate programs to determine effectiveness.

**Objective 3.5. Local communities and local governments will have a higher level of support for estuarine and coastal stewardship.**

Strategy: Work with Stewardship Coordinator to train and educate citizens to participate as volunteers in education activities.

Strategy: Complement existing education programs with additional community education opportunities, including targeting underserved populations.

Strategy: Continue to implement educational programs that improve awareness and build community-level support for estuarine and coastal stewardship.

## **6.5 Education Approach and Efforts at CBNERR-MD**

### **6.5.1 CBNERR-MD Overall Approach**

The true strength of the NERRS and therefore the CBNERR-MD education programming is its use of authentic data to tell the stories and describe the issues in the Chesapeake Bay estuary. The integration of CBNERR-MD across the various sectors is essential to capitalize on this strength. At the root of all CBNERR-MD programming is many years worth of SWMP and other research and monitoring data that can be interpreted to describe numerous trends relevant to the citizens and students of the Bay's watershed. As research questions continue to be answered, the education program will communicate the most up to date research results to multiple audiences.

This focus on research and working with authentic local data allows the education program to apply the constructivist education model in which the students build understanding of the estuarine systems through authentic investigations focused on a particular issue. This education model is a recommended structure for the Maryland State Department of Education's (MSDE) voluntary State curriculum (VSC). The K-12 programs developed by the Reserve and its partners are tied to the VSC through both the environmental education curriculum and as an integrating theme tying multiple subject areas together.

Although estuaries are not the focal point of any part of the Maryland curriculum, the Chesapeake Bay has been established as an important part of the student's education. Within MSDE the Environmental Education program exists to "enable students to make decisions and take actions that create and maintain an optimal relationship between themselves and the environment, and to preserve and protect the unique natural resources of Maryland, particularly those of the Chesapeake Bay and its watershed."<sup>1</sup> One important element of this is the use of authentic data, gathered both through student work and through official systems like SWMP and DNR's Eyes on the Bay. Working with this type of research and data is directly in line with NERRS educational strengths and is therefore one of the gaps that the CBNERR-MD education program will aim to fill

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<sup>1</sup> MSDE website: <http://www.marylandpublicschools.org/MSDE/programs/environment>

though both teacher professional development and student programs.

Essential to the growth and development of the CBNERR-MD education program is initiating the evaluative process. This process will help determine CBNERR-MD's effectiveness in addressing the gap and providing meaningful programming to participants. Furthermore, a comprehensive needs assessment and market analysis, when conducted, will allow the Reserve to have the most effective presence possible in Maryland.

### **6.5.2 Otter Point Creek - Education**

Education policies and programs for Otter Point Creek were developed by the Reserve Education Coordinator with assistance and advice from the Site Manager, the Reserve staff, site staff and advisory committees. The Education Coordinator works with Harford County Department of Parks and Recreation and other organizations in the area to augment the ongoing educational activities conducted by these organizations.

The focus of education and interpretation programs is estuarine ecology and the watershed's natural history. Several trails are located at this component that are used to promote environmental awareness among all user groups. One trail highlights the importance of native landscaping as a way to attract wildlife and improve water quality.

The Anita C. Leight Estuary Center contains an exhibit hall, Discovery Room, library, conference room, lab and offices. The Center is the focus of the education programs and allows the public to view the exhibits and enjoy the trails. All component information is disseminated from this Center and the Center serves as a community resource for workshops, meetings, and education and research activities. Opened in 2003, exhibits in the Anita C. Leight Estuary Center focus on the importance of change, both natural and human induced, in the Chesapeake Bay and on ways people can help protect the Bay. These exhibits also provide information about the native plants and animals found in the area. A turtle pond in the Discovery room houses several species of native turtles and is the most popular attraction.

Through the efforts of Reserve staff, especially the Education Coordinator, the Anita C. Leight Estuary Center offers many opportunities for learning. These include:

- Coastal Decision Maker Workshops and Coastal Training Programs have been held here, attracting planning and zoning officials from Harford and Baltimore Counties. One series of workshops focused on Rain Gardens, a form of stormwater management that utilized plants to control and even utilize runoff.
- An Environmental Science Investigation was developed cooperatively with Reserve and site staff. In this program 7<sup>th</sup> grade students are asked to evaluate a request from a business to expand a local marina. Students assess the potential impacts to water quality and submerged aquatic vegetation and make recommendations to county officials.
- High school monitoring programs have also been developed which focus on water quality, submerged aquatic vegetation and wood ducks.
- A cooperative program with Harford Glen Environmental Center (Harford County

Public Schools' Environmental and Outdoor Center) for 7<sup>th</sup> graders focusing on submerged aquatic vegetation.

- An internship program which offers field research experience to qualified college students.
- Site staff provide teacher workshops for all grade levels, including Project WET, Project WILD and Learning Tree. Year round public programs such as canoe and pontoon boat programs, nature exploration and summer nature camps, etc. are offered. Many programs are offered in cooperation with local organizations such as the Harford Bird Club, Master Gardeners, and Tri-County Deer Management Association. The Izaak Walton League conducts hunter safety classes and clean ups and assists the Site Manager with some educational programs.

### **6.5.3 Jug Bay - Education**

Patuxent River Park (PRP) and the Jug Bay Wetlands Sanctuary (JBWS) each offer a variety of educational programs, nature experiences and learning opportunities for the public. Each site has a large visitor center with interpretive displays and exhibits. JBWS restricts public use, via a "limited use policy" in order to reduce the impact of visitors on wildlife and habitats. To carry out this policy, most of the JBWS is only open to the public three days a week and visitors are asked to make a reservation before their visit. Patuxent River Park is open to the public seven days a week. Horseback riding, dockside fishing and boat launching take place at Patuxent River Park, whereas these activities do not take place at JBWS.

Reserve educational programs at this component focus on activities that can be conducted cooperatively with both component sites or activities that transfer between components. The program organized for Estuaries Live, an internet broadcast for school children hosted by NOAA and EPA, is a good example of this. Reserve staff also conduct canoe based programs and nature hikes as well as assist site staff with various programs and summer camps.

#### **6.5.3.1. Patuxent River Park**

In Patuxent River Park, the Jug Bay Natural Area / Black Walnut Creek Nature Study Area, is dedicated to nature study and environmental education. Guided interpretive hikes along boardwalks are conducted by experienced naturalists. Education topics include plant and animal identification, natural history, wild rice ecology, ecosystem processes and folklore. Interpretive boat tours on the Patuxent River emphasize wetlands ecology and are available for groups from April through October. A pontoon boat is used to allow observation of the river's wetlands and wildlife. The boat and the study area are both designed to accommodate senior citizens and individuals with disabilities. Canoes and kayaks are available for rent. Reserve visitors may also participate in naturalists led tours.

Patuxent River Park has recently completed the buildings (barn, slave quarters, blacksmith shop, etc.) and developed the programming for a living history museum in which local elementary school students learn about early pioneers in Maryland and how they lived. The park also built a new structure that houses a wet lab for use in

educational programming. This lab will become a focal point for educational programming about the organisms that exist within the Patuxent River and the water that supports those organisms.

### **6.5.3.2 Jug Bay Wetlands Sanctuary**

Jug Bay Wetlands Sanctuary's (JBWS) education mission is to promote environmental awareness and ecological understanding, a mission compatible with and complementary to the educational programs of the Research Reserve. Exhibits in the McCann Wetlands Center focus on wetlands, estuaries and the processes that make the ecosystem function.

Both adults and children are participants in the ecology focused programs. This is accomplished in two ways. Marsh field programs and other activities are designed and planned by site and Reserve staff in partnership with the teachers for groups of students that visit the Sanctuary. Students learn to identify amphibians and plants as well as use water testing kits to assess water quality. Trails and boardwalks also offer opportunities for education and are considered outdoor classrooms. These are maintained for safe access and some boardwalks are wheelchair accessible. To preserve fragile habitats, educational activities are limited to certain areas. The Sanctuary also participates in cooperative education programs with a variety of other organizations such as Johns Hopkins University, the US Naval Academy, Anne Arundel County public schools, and a number of community colleges. Special courses and workshops are provided for school teachers that help them to gain a better understanding of estuaries and how they can incorporate related subject matter into their classrooms as well as incorporate field experiences. A summer college intern program is available for qualified university students.

Additionally, citizen volunteers learn how to study plants, animals and water quality. These studies are used to provide data on the long-term health and ecological condition of the wetland and upland habitats at Jug Bay. These studies are coordinated by JBWS staff naturalists. The Sanctuary publishes technical research reports based on this research. JBWS also publishes a quarterly newsletter, brochures, trail guides, checklists, volunteer guides, and historical and archaeological information. The Sanctuary also maintains a research library and a storehouse of data on Sanctuary flora, fauna, and water quality. The web page is [www.jugbay.org](http://www.jugbay.org).

### **6.5.4 Monie Bay - Education**

The 13,323-acre Deal Island Wildlife Management Area, including the Reserve at Monie Bay, provides public access for recreational uses such as hunting and trapping. The physical characteristics of the site, the small number of access points and the lack of facilities, especially restrooms, limit the number of visitors to the component. These same restrictions limit the number and type of educational programs that can be offered.

There are some underdeveloped trails in upland forests and forested wetlands in the component. Some types of educational programming will require improvements to the trail system to facilitate access.

The Reserve Education Coordinator and the Site Manager work together to determine the most appropriate educational activities. One highly successful program, Wetlands and Wildlife Field Day, was initiated in 1994 and has been offered annually. This program is jointly sponsored and conducted by the Reserve and the Wildlife and Heritage Service at DNR. Before the initiation of this program, Somerset County curriculum indicated that fourth grade students study the Chesapeake Bay and its ecosystems in school. However, these students received little or no information about the marshes surrounding their homes and schools. Therefore, the Wetlands and Wildlife Field Day program was targeted to this age group. Students and teachers participate in a series of stations that teach them about the value of marshes and about the plants and animals that live there. Since the inception of this program, over 3,000 students, their teachers and some parents have participated in the program. In the past several years, students who benefited from the program as fourth graders have returned as high school seniors to help as mentors and logistical facilitators.

A Coastal Decision Maker Workshop on the “Role of Phragmites in the mid-Atlantic” was held in the Monie Bay area. Over 75 participants from Maryland, Virginia, Delaware, New Jersey, Connecticut and Massachusetts attended this informative workshop. Other educational activities conducted in the Reserve at Monie Bay include: bird banding demonstrations, tours of the component and the impoundment area of the Deal Island WMA and talks about native animals. The Education Coordinator and the Site Manager continue to explore partnerships with area universities, especially the University of Maryland Eastern Shore.

## **6.6 Key Partners**

Much of the Research Reserve’s programming has been based out of the Jug Bay and Otter Point Creek components due to the lack of facilities and staff at Monie Bay. However there is a definitive need to develop and encourage more environmental education opportunities for multiple audiences, including students, teachers, decision-makers and the general public, on the lower Eastern Shore in the vicinity of the Monie Bay component. Therefore the Research Reserve will need to work in partnership with other organizations and agencies to develop these opportunities.

The Reserve’s Partnership with the Maryland State Department of Education (MSDE) in the development and implementation of ocean/estuarine literacy courses in Somerset County High Schools is a good starting point for this effort. This partnership initiated a program that has already served 2000 students in both comprehensive coursework focused on authentic data and enriching field experiences. Ideally, the results of this partnership will continue to be the model for additional ocean/estuarine literacy courses in other counties.

Through the DNR Education Matrix Team, CBNERR-MD maintains communication other DNR education partners including educators from State parks, the Maryland Conservation Corps, and DNR’s Education group.

Another key education sector partner is the Maryland Association of Outdoor and Environmental Education (MAEOE). Through a partnership with this association,

CBNERR-MD has helped to implement the Maryland Green Schools Program. This program is intended to increase the environmental literacy of students throughout Maryland by providing a comprehensive framework for both studying and protecting the regions natural resources.

## **6.7 Future Directions**

The Research Reserve is well positioned to facilitate educational opportunities that may ultimately lead to behavior changes and actions that result in improved estuarine conditions. Currently, the achievement of the goals that were set by the Chesapeake 2000 agreement is in doubt but as behaviors change, appropriate actions are taken, and informed decisions are made, the Bay's health will improve. The Reserve can help to establish a pathway for individuals (students, teachers, decision-makers and other portions of the citizenry) to become informed about the estuary, involved in its restoration, and ultimately provide leadership in the effort to achieve a healthy estuarine system. This pathway will promote the strengths of the Reserve and allow access to its resources for the long-term engagement of individuals participating in this pathway. The pathway may begin with students in a classroom studying the estuary, to participation in field experiences, to research and stewardship internships and opportunities. The role of the Reserve will be to promote and facilitate participation in this pathway as the students and other individuals move through it by providing, in partnership with others, educational, stewardship, internship/research, and leadership opportunities.

There is also a real need within the education community for Climate Change Training especially for environmental educators, naturalists and teachers. Programming in this context fits very well with our management issues and our positioning within DNR and partner agencies. It is in the context of CBNERR-MD helping to train the other educators in the region that represents the area in which the program is likely to grow the most.

*Otter Point Creek.* Otter Point Creek is contained within a rapidly developing region of Maryland that is expected to continue developing at an accelerated rate, in part due to the US Army Base Realignment and Closure (BRAC). Management issues associated with human population growth and development will drive educational programming. Programs for multiple audiences will illustrate the changes in land use, and consider the consequences of those changes on the estuary. Such educational programming will be accomplished through the use of GIS and other mapping tools in conjunction with both archived and real-time SWMP data and may also include other data sources (e.g., nutrient data, larval fish data). Through this type of programming, participants will develop an understanding of the consequences of development and potential strategies for mitigating those consequences as students, teacher, and citizens.

*Jug Bay.* Educational programming at the Jug Bay component is currently very strong and the addition of new facilities at both the Anne Arundel (Plummer House) and Prince George's counties (plankton lab) will enhance this programming. In particular, the incorporation of the Glendening Nature Preserve into the Research Reserve will allow for closer study of the influence of the larger watershed on the Patuxent River and the Chesapeake Bay. This will be accomplished through the monitoring of water quality and biota in two streams that flow through the Preserve, both of which have very different

characteristics due to the influence of the stream's watersheds. Additionally, the Education Coordinator will work with the county partners to encourage more cooperative programming between the two sides of the river.

*Monie Bay.* Being the most undeveloped and remote location within the Reserve with no facilities or infrastructure and no easy access, Monie Bay holds a great deal of potential for future educational programming. The nature of this programming will depend greatly on any land acquisitions and building that may occur in this component of the Reserve. As new programs are developed, one of the most significant issues impacting Monie Bay is climate change and its impacts, particularly sea level rise. Therefore future education programs utilizing this component will focus on climate change impacts, and tell this story through the use of SWMP data and other tools and data (Surface Elevation Table (e.g., Maryland's Shorelines Online, LIDAR elevation data, Surface Elevation Table (SET) data, and biomonitoring data). Other potential future educational programs at Monie Bay include:

- Continuation of the highly successful Wetlands and Wildlife Field Day.
- Programs that may be identified in follow-up to the Monie Bay socio-cultural needs assessment (*Linking Estuarine Ecology and Community Heritage: A Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005) such as informal presentations/talks to inform local citizens about the Reserve, local environs and its relation to the local lifestyle.
- Guided canoe trips through the component or the impoundment to teach people about the native flora and fauna and improve estuarine literacy.
- Seining to identify and track fish species utilizing the area.
- Bird watching tours around the impoundment or accessible areas of the component.
- Ecology walks through the component to identify various plant species, discuss their functions, and learn about various ecological processes.
- Working with the Wildlife and Heritage staff to conduct Hunter Safety programs.
- Developing a partnership with Somerset County schools and Maryland State Department of Education to develop estuarine literacy programs for high school students.

Overall at CBNERR-MD, education programs have increased in volume to serve over 2,800 K-12 students with over 140 education programs in the last recent grant period (October 1, 2006 to September 30, 2007). The focus for the next five years will be to increase the number of programs at Monie Bay, raise the bar on the academic quality of education programs, tie programs more closely to State education standards, and use authentic data and student-derived questions in more programs.



## 7. COASTAL TRAINING PROGRAM

### 7.1 Introduction

An effective Coastal Training Program (CTP) will help to achieve the goals of the National Estuarine Research Reserve System (NERRS) as a whole, as well as the goals of the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) and the Maryland Department of Natural Resources (DNR).

The CBNERR-MD Coastal Training Program provides up-to-date scientific information and skill-building opportunities to coastal decision-makers who are responsible for making decisions that affect Chesapeake Bay and its tributaries. Through this program Reserves can ensure that coastal decision-makers have the knowledge and tools they need to address critical resource management issues of concern to local communities.

Throughout the NERRS, Coastal Training Programs offered by Reserves address such topics as habitat conservation and restoration, biodiversity, water quality, and sustainable resource management, and they integrate reserve-based research, monitoring and stewardship activities. Targeted audiences vary throughout the National Estuarine Research Reserve System, and can include a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profit organizations, businesses and business associations, and applied scientific groups.

The Coastal Training Program is designed to bring professionals to network across disciplines and develop new collaborative relationships to solve complex environmental problems. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a reserve-based field activity. Additionally, the Coastal Training Program includes a rigorous evaluation process to ensure that professional stakeholders inform local and regional science and research agendas.

### 7.2 Chesapeake Bay Context: Coastal Training and Outreach

In the Bay region there are many public and private organizations providing outreach and education (primarily to the general public) on a variety of Chesapeake Bay management and conservation issues. See Table 4 for a partial list of training and outreach providers. Provider assessments indicate that two of the most frequently targeted audiences are the general public and local government staff. However, provider assessments also identified both local government staff and elected officials as groups in need of additional training and resources. Many training providers offer outreach and education but do not offer trainings that foster the

**Table 4. Examples of Key Training Providers in Maryland**

CBNERR-MD
other DNR groups including Chesapeake and Coastal Programs
Sea Grant
University of Maryland Cooperative Extension
Center for Watershed Protection
Chesapeake Bay Trust
Chesapeake Bay NEMO (Network for Education of Municipal Officials)

transfer of skills needed to address a specific topic and result in changes at the local level. Of the providers offering this type of service many do not have the capacity to meet the needs of the audience. In addition, there is a clear need in the region to provide training in a more coordinated and collaborative manner to avoid redundancy, leverage funding and staff time, and meet the rising needs at the local level to address Chesapeake Bay restoration goals.

The CBNERR-MD Coastal Training Program is in a unique position to offer consistent training or technical assistance that serves as a mechanism to get relevant research and data to the local users making decisions. This need is not being adequately met by current programs. The evaluation tools that are built into the Coastal Training program spawn more effective trainings that meet the needs of local constituents. Another key role that the Coastal Training Program can provide in Maryland is to act in a coordinating role and possibly serve as a communication link among regional providers to further enhance existing programs to meet local needs.

### **7.3 CBNERR-MD Management Issues**

The Coastal Training Program provides science-based information, tools and techniques to professionals making decisions affecting Chesapeake Bay resources. Through this program, decision-makers have the opportunity to gain valuable information and build their working knowledge of critical Bay issues to ensure that sound decisions are being made at the local, State and regional level. Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels. These management issues are the primary drivers of the subject matter communicated through the coastal training programming.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

Underlying all of the CBNERR-MD coastal training programs will be the fundamental management issues of population growth and its impacts on land use as well as a variety of issues related to climate change. With respect to the Coastal Training Program's

primary target audience of local elected officials and their staff, the focus of the coastal training programs will be “Planning for Change: Population Growth and Climate Change.”

#### **7.4 CBNERR-MD Coastal Training Program Goals, Objectives, and Strategies**

The Coastal Training Program is key to fulfilling the CBNERR-MD mission. The Reserve’s mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The following are a set of objectives and strategies that drive the Coastal Training Program efforts while supporting Reserve goals two and three. The Coastal Training Program Coordinator has primary responsibility for these, working together with the other CBNERR-MD DNR staff, site staff, and the Coastal Training Program Advisory Committee.

#### **GOAL 2. Increase the use of science and Reserve sites to address management issues.**

**Objective 2.3. Scientists, professors, and undergraduate and graduate students will have an increased ecological understanding of estuaries and an increased understanding of the relationships among estuaries and human activities, social issues, values, and behaviors through CBNERR-MD research and monitoring.**

Strategy: Conduct on-going needs assessments to collect information on the issues and topics that are important at the local level, and work with Research Coordinator to ensure that Reserve research is relevant and useful to Coastal Training Program target audiences (particularly local elected officials and local government staff).

#### **GOAL 3. Enhance peoples’ ability and willingness to make informed decisions and take responsible actions that affect Maryland’s coastal communities and ecosystems.**

**Objective 3.2. Maryland’s urban and rural citizens will have an increased understanding of the ecological, economic, historical and cultural importance of estuarine and coastal resources and how human choices and natural disturbances impact social, economic and estuarine ecological systems.**

Strategy: Work with Research Coordinator to translate research results into relevant, meaningful, and accessible information for Maryland’s urban and rural citizens.

**Objective 3.3. Coastal decision-makers will receive knowledge, information, and skills to improve coastal management.**

Strategy: Work to achieve Coastal Training Program (CTP) goals in consideration of

priority management issues for CBNERR-MD:

- Improve coastal decision-makers' and citizen understanding of the impacts of human population growth, land use, and development practices on water quality, aquatic habitat, living resources and socio-economics, and on techniques to effectively plan for and mitigate these impacts.
- Improve coastal decision-makers' and citizen awareness of subsidence, erosion, and water level changes and the associated ecological and socio-economic impacts, and on techniques to effectively plan for and mitigate these impacts.

Strategy: Solicit input from the Coastal Training Program Advisory Committee to guide the direction of the Coastal Training Program.

Strategy: Develop a process with other key partners to enhance collaboration and partnering among training and outreach providers to increase effectiveness of programs and promote behavior change.

Strategy: Work with NERRS and the Reserve's partners to implement the Coastal Training Program, including implementing the CBNERR-MD Coastal Training Program Strategy and Marketing Plan.

Strategy: Ensure that individuals and organizations with decision-making responsibility affecting the Chesapeake Bay and its watershed (particularly CBNERR-MD CTP target audiences) receive scientific information in a usable form.

- Coordinate the interpretation and dissemination of information to CTP audiences.
- Encourage all researchers working within the Reserve, particularly the Research Coordinator, to participate in professional scientific meetings and then translate the latest scientific information into a learning opportunity for coastal decision-makers.
- Develop programs through the Coastal Training Program and activities to share information learned through SWMP and other research about the Bay with appropriate target audiences.

**Objective 3.4. Coastal decision-makers will use science-based information in making decisions that will affect coastal and estuarine resources.**

Strategy: Work with Education Coordinator to build the political will that will encourage decision-makers to use science-based information in decision-making. For example, use social marketing techniques to encourage Marylanders to use sound land use planning and development practices to:

- Minimize long-term environmental impacts on water quality, habitat, living resources and socio-economics.
- Minimize future damage and losses due to sea level rise and coastal hazards.

Strategy: Provide trainings that encourage coastal decision-makers to use science-based information in decision-making through the Coastal Training Program.

- Provide science understanding trainings to coastal decision-makers to develop the required understanding and will to use science information in making decisions.
- Provide technical trainings to coastal decision-makers (and their staffs) that allow them to use technical tools in decision-making (e.g., GIS tools, Maryland's

Shorelines Online mapping tool, etc.).

- Provide policy implementation trainings that show decision-makers how to navigate hurdles, remove impediments, and implement effective policies that use science in decision-making.

## **7.5 Coastal Training Program at CBNERR-MD**

The CBNERR-MD Coastal Training Program was developed in a systematic manner. An advisory group representing key stakeholders was formed to provide ongoing guidance and direction for program development.

During the development phase of the program a market analysis was conducted to assess the existing training programs in the region. Through this analysis it was determined that there is a niche for the Coastal Training Program in Maryland. The initial target audience for the program will be elected or appointed officials and staff at the county and municipal level. Staff may include local staff in planning and zoning, parks and recreation, public works and other relevant agencies. Other target audiences may include:

- Developers, builders, architects, and real-estate professionals.
- Non-profit environmental organizations with an emphasis on watershed organizations and land trusts.

As the Coastal Training Program develops and evolves other target audiences will likely be identified.

A needs assessment was conducted to determine the knowledge, skills and attitudes of the audience on resource management issues and to identify preferred training delivery mechanisms. Based on the input from the initial assessments, the advisory committee, and key stakeholder interviews, a three-year program strategy and marketing plan was developed.

Prior to October 2007, Chesapeake Bay NERR MD was conducting three Decision-Maker workshops yearly that covered a broad range of topics. The Coastal Training Program is expanding on this success and developing a more focused and targeted program to meet local and regional needs. The Coastal Training Program provides three types of trainings that encourage coastal decision-makers to use science-based information in decision-making:

- Science understanding trainings help decision-makers develop the required understanding and will to use science information in making decisions.
- Technical trainings allow decision-makers to use technical tools in decision-making (e.g., GIS tools, Maryland's Shorelines Online mapping tool, etc.).
- Policy implementation trainings show decision-makers how to navigate hurdles, remove impediments, and implement effective policies that use science in decision-making (e.g., county code amendment).

Topic areas can include (but are not limited to):

- effects of different land uses, management practices and development practices on coastal resources
- climate change and subsidence, erosion, and water level changes
- integrating reserve-based research into local decision-making
- habitat conservation and restoration
- water quality monitoring
- building capacity to reach consensus and conflict resolution

## **7.6 Key Partners**

Partnerships are a critical component in the success of the Coastal Training Program not only to implement trainings but also to determine local resource issues and target audiences. Key partners include the State coastal program, Sea Grant extension agents, Critical Area Commission, Tributary Strategies, Chesapeake Bay Trust, municipal and county agencies, EPA and NOAA Chesapeake Bay Programs, the business community, and other local entities including citizen groups and non-profits. Partners at the local level are essential to ensure that relevant and accessible training programs are being delivered that meet the needs of the targeted audiences.

## **7.7 Future Directions**

The Coastal Training Program will continue to define the needs of local constituents and offer relevant trainings. Ongoing needs assessments will occur throughout the next five years to continuously determine topics of interest from which to develop programs. Programs will be focused primarily for the next three to five years in the geographic regions where the Reserve components are located, and will then be expanded to all coastal counties in Maryland as the program grows and the needs are better understood.

## 8. STEWARDSHIP—RESOURCE PROTECTION AND MANAGEMENT

### 8.1 Introduction

The health, productivity, and integrity of the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) resources must be protected and, where necessary, restored in order to provide a stable environment for research, monitoring, and education programs, which are used to address coastal management issues. An effective and coordinated Stewardship Program will help to achieve the goals of the National Estuarine Research Reserve System (NERRS) as a whole, as well as the goals of CBNERR-MD and the Maryland Department of Natural Resources (DNR).

Meeting Reserve goals requires not only direct management of Reserve lands, but also the sound stewardship and management of lands outside of the Reserve. The Reserve components are critical links in the ecological hub and corridor network defined by Maryland's Green Infrastructure Assessment (GIA). The GIA is Maryland's extensive process for identifying key ecological hubs and corridors in need of protection. The on-site resource values are, in part, derived from the ecological network, landscape and watershed-scale setting. The GIA is an important tool for guiding planning, zoning, and land use decisions external to the Reserve to areas and watersheds that provide beneficial resource protection. Restoration opportunities, known as Green Infrastructure Gaps, have also been identified and prioritized by the GIA. Restoring Gaps, both within and outside of Reserve components, will also give landscape scale ecological benefits to the network of which the Reserve components are a part. For more information on Maryland's Green Infrastructure Assessment, go to: <http://www.dnr.State.md.us/greenways/greenprint/>.

The Reserve Stewardship Coordinator will work with other CBNERR-MD DNR staff, site staff, and volunteers to protect and restore the Reserve components for long-term research and education and to promote a sense of stewardship throughout the neighboring communities.

### 8.2 Chesapeake Bay Context: Stewardship

Protection and restoration efforts are conducted by many public and private groups in the Chesapeake Bay region.

Lands are protected through acquisition or easements by local and national private land trusts (e.g., the Conservation Fund), county programs, State programs (e.g., Program Open Space, Rural Legacy, Maryland Environmental Trust), and federal land acquisition programs (e.g., Coastal and Estuarine Land Conservation Program—CELCP, NERRS).

Fisheries in Maryland are protected by DNR's Fisheries Division, which writes fishery management plans and regulates harvests. Bi-state commissions address bay-wide fisheries protection. Wildlife populations are managed and protected in Maryland through the DNR's Wildlife and Heritage group, and public forests are managed by DNR's Forestry Division.

Restoration activities are conducted by DNR, local governments, watershed groups, waterkeeper organizations, and other non-profit organizations. In addition, restoration is required as mitigation for development projects by federal and State environmental protection laws (such as Maryland's Critical Area law and the U.S. Clean Water Act) and local regulations. Thus, many for-profit businesses engage in restoration activities to help their clients comply with environmental laws and regulations. DNR restoration activities in Maryland include bay grasses (SAV) restoration, stream restoration, and oyster restoration projects.

CBNERR-MD will coordinate with others involved in restoration to avoid duplication and to leverage resources and expertise.

### **8.3 CBNERR-MD Management Issues**

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

CBNERR-MD will address these stressors by striving to protect the Reserve areas through land acquisitions in an effort to acquire parcels that border the Reserve areas, parcels that encompass tributaries that empty into the Reserve areas, and parcels of concern, in order to prevent these lands from being degraded. These acquisitions are acquired using Maryland's Green Infrastructure Assessment (GIA) and other tools to determine the most sensitive areas, and to help to rebuild the fragile hubs and corridors.

To address the climate change stressor, CBNERR-MD will target wetlands, as well as undeveloped uplands in low elevations adjacent to those wetlands, to allow the uphill migration of marsh and wetland areas (marsh creep) with impending sea-level rise.

CBNERR-MD will assist in coordinating restoration projects at each Reserve component to sustain animal populations, important habitats, and healthy water quality. CBNERR-

MD will work with sites to determine their individual needs (e.g., wild rice restoration, SAV restoration, invasive species removal, deer management, resident geese management).

#### **8.4 CBNERR-MD Stewardship (Resource Protection and Management) Goals, Objectives, and Strategies**

Effective stewardship is key to fulfilling the CBNERR-MD mission. The Reserve's mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

Reserve goals are linked to and supported by the Reserve Stewardship Program. The following are a set of objectives and strategies that drive stewardship efforts for Reserve goals. The Stewardship Coordinator has primary responsibility for implementing these strategies, working together with site staff, other CBNERR-MD DNR staff, and volunteers.

#### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

##### **Objective 1.3. The long-term integrity and diversity of Reserve habitats will be maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

Strategy: Explore opportunities for acquiring or protecting additional property to include within the Reserve.

- Complete and update Land Acquisition Plan.
- Implement Land Acquisition Plan.
- Apply for CELCP, NERRS Construction and Acquisition, and Program Open Space (POS) funding as appropriate.
- Work with partners (e.g., counties) to leverage other funding sources (e.g., county POS funding).
- Acquire properties to serve as key buffer areas adjacent to and upstream of all three Reserve components as described in the Land Acquisition Plan (in development).

Strategy: Identify sensitive habitats and species that are unique or rare, evaluate threats to them, and work to determine the actions necessary for ensuring their long-term viability.

Strategy: Protect the habitats of birds and other wildlife as an integral part of the natural system.

Strategy: Work with site staff, DNR personnel, and others to restore degraded areas where appropriate and when fiscally feasible.

Strategy: Explore additional federal and State designations to areas within the Reserve

(e.g., wildland areas) as appropriate.

Strategy: Work with partners to develop appropriate policies and enforcement that control access to all Reserve components to the extent possible.

Strategy: Aid in enforcement of permitted uses of the Reserve components.

Strategy: Be knowledgeable of and involved with land use issues in the vicinities of the Reserve components that could impact the Reserve. Specifically, stay apprised of activities in the Reserve watersheds that may impact the integrity of the Reserve components and work with Reserve staff and others to mitigate or study/document any impacts to the Reserve.

Strategy: Coordinate with State and federal authorities to help prevent degradation of the components by outside activities.

Strategy: Ensure that protection documents (such as Memoranda of Understanding and conservation easements) are updated and adequate to protect the Reserve components.

Strategy: Identify any degraded areas within the Reserve component boundaries and their watersheds.

Strategy: Promote implementation of the Bush River Watershed Management Plan (2003) recommendations, including:

- Preservation of large wetland tracts
- Implementation of specific stormwater retrofits
- Stabilization of several areas of Otter Point Creek to improve stability and lessen sediment transport
- Heightened plan review of the area

Strategy: Conduct land stewardship and resource management and restoration efforts, train volunteers to assist with these efforts, and evaluate the effectiveness of restoration efforts. Examples include:

- Removal of invasive species (e.g., purple loosestrife, Japanese stiltgrass).
- Help to facilitate managed hunts when an overabundance of animals is damaging the ecosystem (e.g., deer, resident Canada geese, mute swans).
- Employ GIS to analyze success of restoration efforts in Jug Bay, particularly wild rice restoration.

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Acquire additional property and provide needed facilities within the Reserve for staging research, education, and community programs.

- Acquire suitable property with road access, water access, and high ground suitable for Research/Education/Cultural Visitor Center and other needed facilities at Monie Bay (where there are currently no facilities). Use CELCP, NERRS Construction and

Acquisition, and Program Open Space (POS) funding as appropriate.

Strategy: Maintain, design, and build nature trails, boardwalks, and overlooks.

- Work with volunteer organizations and solicit new volunteers to get assistance with building projects.
- Develop partnership with Maryland Conservation Corps to assist with projects.
- Work with Harford County and Izaak Walton League to improve, build, and ensure maintenance of nature trails at both Leight Park and Bosely Conservancy (Otter Point Creek).
- Work with Anne Arundel County Recreation and Parks to maintain and improve existing boardwalks and trails and build new ones at Jug Bay Wetlands Sanctuary (Jug Bay).
- Work with Patuxent River Park to provide assistance as requested and possible at Jug Bay Natural Area (Jug Bay).
- Design and build nature trails and boardwalks at Monie Bay.

## **GOAL 2. Increase the use of science and Reserve sites to address management issues.**

### **Objective 2.4. The CBNERR-MD Research Program will have increased governmental and community support.**

Strategy: Promote the visibility and transfer of information about the Reserve and translate pertinent scientific information to a variety of audiences, including volunteers and other community participants.

Strategy: Continue to support stewardship opportunities through volunteer and friends groups such as Otter Point Creek Alliance and Friends of Jug Bay.

Strategy: Work with site staff and Wetlands and Wildlife Field Day partners and develop new partners at Monie Bay to initiate plans for a volunteer program.

Strategy: Support stewardship opportunities for citizens.

## **GOAL 3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.**

### **Objective 3.2. Maryland's urban and rural citizens will have an increased understanding of the ecological, economic, historical and cultural importance of estuarine and coastal resources and how human choices and natural disturbances impact social, economic and estuarine ecological systems.**

Strategy: To foster a sense of stewardship in the broader community, engage local citizens as volunteers in research and monitoring projects so they can learn first-hand the importance of estuarine systems and how human choices and natural disturbances impact estuarine ecological systems.

Strategy: Work with various volunteer groups and friends groups (such Friends of Jug Bay and Otter Point Creek Alliance) to train and educate citizens to participate in restoration activities.

Strategy: Develop the utility of CBNERR-MD web site to transmit information to and from volunteers.

**Objective 3.5. Local communities and local governments will have a higher level of support for estuarine and coastal stewardship.**

Strategy: Assist in the implementation of volunteer watershed monitoring and restoration programs. Ensure transfer of skills and information between the components when appropriate. Program may include, but is not limited to: water quality, submerged aquatic vegetation, reptiles and amphibians, fish, benthic macroinvertebrates and birds. Volunteer monitoring programs should provide valuable data to the Reserve and to other groups within DNR.

Strategy: Ensure that facilities and programs developed at Monie Bay consider the needs of the community as discerned through the Monie Bay socio-cultural needs assessment (*Linking Estuarine Ecology and Community Heritage: a Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005) and ongoing outreach efforts in the Lower Eastern Shore, particularly with respect to minority communities.

Strategy: Develop and implement a volunteer action plan for the Reserve to provide training and education for volunteers.

Strategy: Assist with volunteer field trips and events.

**8.5 Stewardship Efforts at the CBNERR-MD**

**8.5.1 Otter Point Creek**

All land managed by Harford County, which includes Leight Park, is covered by Chapter 185 of the Harford County Code, Section 185-1 through 185-22. These rules regulate such things as: need for permits, destruction of park property, fires, animals, fishing, operation of a watercraft, swimming, camping, horses, trespassing, peddling and soliciting, possession of firearms and other items effecting the safe operation of a park. Leight Park staff work with the DNR's Natural Resources Police and the Harford County Sheriff's office to enforce these regulations.

In the *Bush River Watershed Management Plan* (April 2003) the watershed was divided into four types:

- 1) Sensitive subwatersheds which have an impervious cover between 0 and 10 percent
- 2) Rurally impacted which have an impervious cover of 0 to 10 percent, but may be degraded due to livestock access, grazing and cropping practices
- 3) Impacted which have an impervious cover from 11 to 25 percent and show signs of degradation due to urbanization

- 4) Impacted Special Resource which have an impervious cover ranging from 11 to 25 percent, but also have notable natural resource areas (this includes the Otter Point Creek drainage)

CBNERR-MD will work with partners to support the stewardship recommendations in the *Bush River Watershed Management Plan*, which include:

- Preservation of large wetland tracts
- Implementation of specific stormwater retrofits
- Stabilization of several areas of Otter Point Creek to improve stability and lessen sediment transport
- Heightened plan review of the area

### 8.5.1.1 Special Features at Otter Point Creek

#### Shoreline Habitat

The shoreline area of Leight Park has been designated by the State of Maryland as a “Habitat of Local Significance” due to the presence of several rare native plant species listed below. Protection of these habitats is addressed by site management.

- Spongy *Lophotocarpus* is a Maryland “rare” species
- Large marsh pink bur-marigold is on Maryland “watch list” status

#### Forest Interior Habitat

The forested areas in the Otter Point Creek and Jug Bay components have potential Forest Interior Dwelling Bird Habitat. The conservation of this habitat is mandated within the Critical Area (COMAR 27.01.09.04) and must be addressed by any project plans. This site contains Class 3 Forest Interior Dwelling Species (FIDS) habitat, the activity guidelines for which follow (Table 5). These guidelines should be incorporated into all project plans.

The presence of FIDS habitat can be confirmed by a qualified observer using standardized procedures outlined in the Critical Area Commission’s document *A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area* (June 2000).

<b>Table 5. Guidelines for Protecting Forest Interior Habitat</b>	
1	Restrict development to nonforested areas.
2	If forest loss or disturbance is absolutely unavoidable, concentrate or restrict development to the perimeter of the forest (i.e., within 300 feet of the existing forest edge), particularly in thin peninsulas of upland forest less than 300 feet wide.
3	Limit forest removal to the “footprint” of houses and to that which is absolutely necessary for the placement of roads and driveways.
4	Wherever possible, minimize the number and length of driveways and roads.

5	Roads and driveways should be as narrow and short as possible; preferably less than 25 feet long and 15 feet wide.
6	Maintain forest canopy closure over roads and driveways.
7	Maintain forest habitat up to the edges of roads and driveways; do not create or maintain mowed grassy berms.
8	Maintain or create wildlife corridors.
9	Do not remove or disturb forest habitat during April-July, the breeding season for most FIDS. This seasonal restriction may be expanded to February-July if certain early nesting FIDS (e.g., barred owl) are present.
10	Afforestation efforts should target (1) riparian or streamside areas that lack woody vegetation, (2) forested riparian areas less than 300 feet, and (3) gaps or peninsulas of nonforested habitat within or adjacent to existing FIDS habitat.

### Archaeological Resources

The Maryland Historical Trust indicates that at least one archaeological site exists in the Otter Point Creek component. Historically, it is the site of Chilberry Hall, the birthplace of Maryland Governor William Paca. An archaeological survey has not been conducted and it is likely that additional sites may be located at Otter Point Creek.

### **8.5.1.4 Stressors and Management Issues at Otter Point Creek**

#### Development

The continuation of high-density development and commercial, industrial, and business activities in the vicinity of Winters Run and Otter Point Creek may have significant impacts on the wetlands ecosystem. In recent years, a large commercial site was developed adjacent to the Bosely Conservancy and additional development can be anticipated.

A new development of homes on the northeast corner of Otter Point Road and Route 40 began in 2002 with additional homes being constructed in 2003. A new development of homes and businesses on Church Creek, which runs into and meets Otter Point Creek just before emptying into Bush River, started in 2000 and continues to be built. Another housing development on the western side of Route 40 was started in 2003. These developments put tremendous pressure on areas such as the Otter Point Creek component for public access and programming. They increase the need to protect the Otter Point Creek component.

#### Ordnance Testing

The southern portion of the Bush River is used by the US Army Aberdeen Proving Ground for periodic ordnance testing and is closed to boaters during these tests. Exploded and unexploded shells remain on the bottom of the river.

#### Boat Traffic

The Amtrak Bridge which spans the Bush River is a major constraint for boats requiring

a clearance greater than ten feet. Since a continuous rail has been installed, opening and closing of the bridge has become a major ordeal involving great expense and labor. The bridge is opened twice a day on weekends only from June 1 to September 30. Although there are three marinas, three yacht clubs, and three public landings upriver of the bridge, many boat owners who live in that area keep their boats in marinas downriver of the bridge. Boat and marina owners located upriver of the bridge are clamoring for an automated split rail system on the drawspan, which would allow for more frequent openings of the bridge. This would bring increased boat traffic from larger boats close to the Reserve with possible adverse impacts on water quality and habitat.

### Illegal Activities

Some poaching, unauthorized vehicle entry, vandalism, and littering do occur in the Otter Point Creek site. The IWLA, the Harford County Sheriff's Department, Harford County Parks and Recreation, and the DNR's Natural Resources Police are working to minimize the occurrence of these illegal activities. Illegal activities have noticeably decreased since public activities and programs have become more frequent.

### Dredging

Dredging in Otter Point Creek outside the Reserve is planned. If this dredging does occur, environmental impacts are anticipated near and possibly also within the Reserve.

## **8.5.2 Jug Bay**

### Patuxent River Park

The Patuxent River Park is part of an effort by MNCPPC to protect the natural/rural character of the land along the Patuxent River in Prince George's County. Land acquisition for this purpose began in the 1970s and continues today, with the goal of bringing all waterfront property along the Patuxent in Prince George's County into public ownership or easements. In the 1980s, MNCPPC enlisted the assistance of DNR in this protection effort.

The goals of the Park are to protect the area's natural and scenic values, while providing for limited amounts of other compatible activities including natural resource-based public recreation, natural history interpretation, and environmental education.

### Jug Bay Wetlands Sanctuary

#### *Jug Bay Wetlands Sanctuary Strategic Plan*

In addition to Reserve goals, the Jug Bay Wetlands Sanctuary has its own strategic plan which will help achieve CBNERR-MD Goals One and Three. CBNERR-MD will support this strategic plan. In general, the Jug Bay Wetlands Sanctuary will:

- Practice stewardship that avoids or minimizes environmental damage in order to maintain diverse and healthy natural habitats;

- Conduct all activities in a way that prevents long-term damage to habitats and natural features, and;
- Restore areas that have been degraded.

Additional details are in the following summary (Table 6).

<b>Table 6. 2004 Strategic Plan Summary – Jug Bay Wetlands Sanctuary</b>	
<b>I. Maintain a peaceful, primitive character</b>	
	1. We will manage and operate the Sanctuary to maintain its quiet, peaceful conditions for the benefit of wildlife and for the long-term enjoyment of the public.
	2. The Sanctuary will be a site primarily for ecological research, environmental education, nature study, hiking, habitat management, bird watching and canoeing.
	3. Educational programs will emphasize environmental awareness and scientific research, activities that foster an understanding and appreciation of the natural world.
	4. Public safety and access will be addressed as they relate to the peaceful nature of the Sanctuary.
	5. Ball fields, golf courses, boat ramps and paved trails are prohibited. Activities, projects and structures will be evaluated prior to construction to consider long-term impacts.
<b>II. Limiting Public Access as a Conservation Tool</b>	
	1. Controlling public access minimizes ecological damage and disturbance to wildlife. Visitation will continue to be controlled by asking visitors and groups to call ahead to make reservations and to report to the Sanctuary office upon arrival.
<b>III. Minimizing or Prohibiting Environmentally Harmful Activities</b>	
	1. We will avoid or prohibit actions that have the potential to harm the Sanctuary environment.
	2. Field mowing, forest thinning or tree removal, tree planting and poison ivy or invasive species control must be evaluated and approved ahead of time. Any proposed use of chemical pesticides must be approved.
	3. Habitat conservation efforts or public access construction projects (wildlife viewing blinds, boardwalks, etc.) must be evaluated prior to implementation. Construction plans will be submitted to regulatory agencies for review and permits.
<b>IV. New Road or Trail Construction</b>	
	1. New road construction as well as regional "cross-Sanctuary" hiker/biker trails will be prohibited. Proposals to build new trails or boardwalks will be evaluated in order to weigh benefits versus negative environmental impacts
<b>V. Hunting, trapping and fishing are prohibited except if required to accomplish specific stewardship or research goals.</b>	
Enforcement: Waterways are patrolled and regulations enforced by the Natural Resources Police at the Maryland Department of Natural Resources. Anne Arundel County Police Department has authority on land.	

### **8.5.2.3 Stressors and Management Issues at Jug Bay**

### Discharges of Treated Sewage Effluent

There are nine discharges of treated sewage effluent upstream of Jug Bay within the Patuxent River Basin. Control of these discharges, particularly control of the nutrients nitrogen and phosphorus, has been a controversial issue for many years.

The closest of these discharges to Jug Bay is from the Western Branch Wastewater Treatment Plant (WWTP). It is located on Western Branch, a tributary that flows directly into the Jug Bay component. The discharge point is slightly over one mile from the Jug Bay portion of the Patuxent River. It is less than one-half mile from the boundary of the Reserve. The Western Branch WWTP controls both phosphorus (year-round) and nitrogen (seasonal) in its over 20 million-per-day discharge (2003).

In 2003, the Reserve added a site to our System-wide Monitoring Program (SWMP) at Iron Pot Landing on the Western Branch to provide additional information about this tributary. Other monitoring stations in the vicinity provide a frame of reference.

### Development

Development in the vicinity of the Jug Bay could also have significant impacts on that component's ecosystem. Some areas near the Reserve are zoned commercial, and recent development proposals to the counties for areas that are adjacent to or drain into the Reserve have alarmed many who are concerned with maintaining the ecological integrity of the Reserve.

### Fishing Pressure

Commercial fishing with pound nets and fyke nets occurs in the Patuxent River at Jug Bay. Recreational fishing also occurs. The Reserve will keep apprised of (and, where possible, coordinate with) DNR and other studies to determine if fishing activities are having deleterious effects to fish stocks or any collateral damage to other native species of concern. Information based on existing scientific studies will be collected and disseminated to all concerned, and the need for additional studies will be determined.

### **8.5.3 Monie Bay**

Primary responsibility for resource protection at Monie Bay lies with DNR's Wildlife and Heritage Service. Its mission is to "conserve Maryland's diverse native wildlife, plants, and the natural communities that support them, using scientific expertise and informed public input." Several uses of natural resources are discussed below that involve resource management. Overall, continuation of these activities, including the Statewide management programs that affect Monie Bay, is seen as beneficial for the Reserve at Monie Bay.

### **8.5.3.1 Stressors and Management Issues at Monie Bay**

#### Hunting and Trapping

The Deal Island Wildlife Management Area, including Monie Bay, is managed to incorporate hunting and trapping in accordance with State and federal guidelines. Management controls are administered by the Wildlife and Heritage Service including schedules for hunting seasons and opening/closure of specific public lands for hunting and trapping. Extensive information on Maryland's hunting and trapping programs, including those that affect Monie Bay, are available via DNR's Internet site [www.dnr.State.md.us](http://www.dnr.State.md.us)

Enforcement of hunting and trapping regulations is conducted by the DNR's Natural Resources Police.

#### Active Habitat Management

In general, management of Wildlife Management Areas includes habitat manipulation intended to benefit selected game species and/or to maintain a desired habitat mix. In this context, Wildlife and Heritage Service personnel perform tasks such as planting wildlife food plots, creating wildlife openings, establishing nesting cover, and restoring wetlands. These activities may take place in both terrestrial and wetland habitats.

In the Reserve's Monie Bay component, active habitat management is limited to food plot establishment/maintenance and maintenance of early successional stages in selected areas.

#### Fishing

Commercial fishing in Monie Bay area includes some net fishing. Monie Creek is also a popular local sport fishing area. Fishing is done from the creek banks and private boats. The bank area near Old Drawbridge Road is particularly popular with local residents. Fishing for rockfish (striped bass) is also very popular in Monie Bay itself.

Fisheries management and regulatory controls are administered by the Fisheries Service in DNR. Controls on the Monie Bay area are applied based on Statewide policy and local area interests/needs.

Enforcement of fishing regulations is conducted by the DNR's Natural Resources Police.

#### Shellfish Harvesting

Public oyster harvesting is essentially absent in Monie Bay due to the very limited local oyster populations associated with the same diseases that have devastated oysters across the Chesapeake Bay (Dermo and MSX). Some private oyster leases are still held but they have tended to exhibit low productivity for the same reason.

### **8.5.4 Enforcement**

The current regulations in effect will continue to be enforced by DNR's Natural Resources Police.

### **8.5.5 Protective Documents**

Memoranda of Understanding and conservation easements provide detailed information about management and protection of the Reserve lands.

#### **8.5.5.1 Memoranda of Understanding (MOUs)**

Memoranda of Understanding (MOU) have been established between the Maryland Department of Natural Resources and Harford County (Otter Point Creek) and Anne Arundel County and the Maryland-National Capital Park and Planning Commission (Jug Bay) for the properties they own inside the Reserve. The MOUs establish a commitment on the part of the local property owners to protect the natural processes and resources of the Reserve component in perpetuity for research and education purposes.

The MOUs describe the relationship between the Department of Natural Resources and the local government property owners and includes information on: goals of the National Estuarine Reserve Research System; the boundaries for the Reserve; land ownership; the facilities that have become part of the Reserve; the administration of the Reserve; the operation, maintenance and uses of any facilities built or to be constructed; specified uses for the Reserve; the process for any dispute resolution between the two parties; possible reasons for termination of the reserve; and any other important issues upon which there must be agreement.

In addition, an MOU between NOAA and DNR was signed regarding the management of the Reserve as a whole, and an MOU between the Tidewater Administration of DNR and the Forest, Parks, and Wildlife Services of DNR was signed regarding the management of the Monie Bay component.

Copies of the MOUs are included in the Appendices as follows:

#### **CBNERR-MD MOU**

Appendix C: Memorandum of Understanding between Maryland Department of Natural Resources (DNR) and the National Oceanic and Atmospheric Administration (NOAA), March 2008.

#### **Otter Point Creek MOUs**

Appendix D.1: Maryland Department of Natural Resources and Harford County regarding Leight Park and NERRS, July 19, 1990.

Appendix D.2: Addendum to MOU between DNR and Harford County regarding expansion of Otter Point Creek component and NERRS, June 15, 2006.

#### **Jug Bay MOUs**

Appendix E: Maryland DNR and Maryland-National Capital Park and Planning Commission regarding Patuxent River Park Jug Bay Natural Area, July 17, 1990.

Appendix F.1: Maryland DNR and Anne Arundel County regarding Jug Bay Wetlands Sanctuary and NERRS, July 19, 1990.

Appendix F.2: Addendum to MOU between DNR and Anne Arundel County regarding Jug Bay Wetlands Sanctuary and NERRS, September 15, 2006. Expansion of the Jug Bay component of the Reserve.

### **Monie Bay MOU**

Appendix G: MOU between Maryland DNR's Forest, Park and Wildlife Service and Maryland DNR's Tidewater Administration, July 1, 1985

### **8.5.5.2 Conservation Easements**

Conservation easements are legally binding documents that restrict certain activities on a property to protect the natural resources. Conservation easements are held on the Izaak Walton League of America property at Otter Point Creek (including a portion of the core area of that component) and on the Glendening Preserve portion of the Jug Bay component (including a portion of the core area of that component). Copies of the conservation easements are included in the Appendices as follows:

#### **Otter Point Creek Conservation Easement**

Appendix D.3: Between the Harford Chapter of the Izaak Walton League of America and the Maryland Environmental Trust. December 20, 1989. 257 acre easement.

#### **Jug Bay Conservation Easement**

Appendix F.4: Parris N. Glendening Nature Preserve (Jacoby Property) Between Anne Arundel County Maryland and The State of Maryland Department of Natural Resources, February 26, 2002. 571 Acre Conservation Easement. (Environmental Easement)

### **8.5.5.3 Covenants - Jug Bay Wetlands Sanctuary**

Anne Arundel County Executive signed a Confirmatory Deed and Declaration of Covenants, which represent an additional protection beyond that already in place via the MOU. During the 20-year celebration of the founding of the Jug Bay Wetlands Sanctuary October 29, 2005, Anne Arundel County Executive Janet Owens directed Anne Arundel County staff to draft covenants that would protect the Sanctuary from uses or land use change that would adversely affect natural conditions in the Sanctuary or otherwise deviate from the original intent of the Sanctuary. These covenants were drafted with input from Sanctuary staff, the Friends of Jug Bay and a previous Reserve Manager (Ken Shanks).

The Anne Arundel County Executive signed the deed covenants at the Annual Meeting of the Friends of Jug Bay (FOJB) held March 26, 2006. Anne Arundel County will hold the covenants, which represent an additional protection beyond that already in place via the MOU with DNR that governs cooperative management of the Sanctuary by the County and the Reserve.

The covenants specify the parcels of land that are affected by their restriction. The parcels covered by the covenants include the entire area recommended for the boundary expansion of the Reserve.

A copy of the covenant is included in the Appendices as follows:

### **Jug Bay Covenants**

Appendix F.3: Confirmatory Deed and Declaration of Covenants, Anne Arundel County, March 26, 2006.

### **8.5.6 Maryland Resource Protection Policies**

Resource protection relies on a number of existing federal, State and local laws and regulations, plus reserve and site property owner policies. Primary responsibility for resource protection and stewardship activities lies with the Site Managers and site staff. Reserve staff, particularly the Stewardship Coordinator, need to be knowledgeable of and involved with land use issues at the component sites that could impact the Reserve.

The National Estuarine Reserve Research System (NERRS) regulations allow for multiple uses of reserves to the degree compatible with each reserve's management plan and consistent with the mission and goals of the NERRS. Traditional activities in the Reserve may continue at levels currently permitted under local and State laws, or under regulations in place with site property owners, as long as these uses do not conflict with the overall goals of the reserve as defined in the management plan.

Public access is encouraged to the extent that it does not conflict with key protection areas. The Reserve works with Site Managers and owners to develop access policies for any land and water areas that do not currently have such policies. Coordinated enforcement of existing regulations and access policies help to preserve cultural resources as well as natural resources. See Chapter 9 for details on CBNERR-MD public access policies.

All projects will use Best Management Practices to avoid degradation of the natural environment and of cultural resources. The use of insecticides, herbicides, and other toxic substances is prohibited in the core areas and strongly discouraged anywhere in the reserve. Toxic chemicals with rapid breakdown and negligible effects on the environment may be used when absolutely necessary with prior approval of the Site Manager and Reserve Manager. Proper disposal of all common pollutants such as crank case oil is mandatory.

***Research is the key use of the Reserve and is given the highest priority in the management plan.*** Interference with research activities can disrupt the effective long-term management of the estuarine systems. Reserve and site staff monitor research areas and will post signs identifying these sites at the various components, if needed. With the exception of samples taken for approved research programs, and fish and game taken from designated fishing and hunting areas, nothing can be removed from the core areas without prior approval of the Reserve Manager and the Site Manager. Plants, animals, minerals or any parts of these (including such things as leaf litter) must remain to protect the integrity of these key areas. Objects and samples can be removed from buffer zones for reserve research or education programs as necessary. Hunting and fishing are permitted only in designated areas.

Certain non-critical areas may be managed to prevent succession and to maintain a diversity of habitat, such as the old field and field sections of the Jug Bay component.

The planning of any construction includes a review of an archaeological survey of the area. A determination is made regarding the existence of known archaeological sites and whether those sites are directly significant and if portions of the site will be disturbed by construction. The Maryland Historical Trust has agreed to review future development plans for construction to evaluate potential effects to cultural resources. Whenever feasible, construction plans will be altered to avoid disturbance to those sites which are determined to be eligible for nomination to the National Register of Historic Places.

In order to protect the integrity of the Reserve, activities that manipulate habitats are not permitted in core areas. Certain manipulative research activities may be permitted in the buffer zones. Any activities that, in the estimation of the State and NOAA, will result in significant long-term impacts on reserve resources will require prior approval of the State, NOAA and the site property owners.

Habitat restoration plays an increasingly important role in degraded areas of the components. Specifically, restoration of submerged aquatic vegetation and emergent aquatic vegetation such as wild rice, especially in the Jug Bay component, are encouraged. Minor restoration such as garbage cleanup, erosion control, and reestablishment of shoreline vegetation can be undertaken where necessary to enhance the research and education value of the Reserve. Only native species recognized as part of the local ecology may be planted.

Because the Reserve components fall under a number of different and sometimes overlapping jurisdictions of local and State agencies, coordination and cooperation among all authorities is essential. State and local regulations that directly affect the components are described below. The Reserve coordinates with many of these regulatory agencies.

### **8.5.7 Maryland Resource Protection Regulations**

The Code of Maryland Regulations (COMAR), which apply to the Reserve, are organized by the agency having the regulatory authority. In this section, the regulations are referenced and very briefly summarized.

## **8.5.7.1 Maryland Department of Natural Resources (DNR)**

### **Fish and Fisheries: Organization and Authority**

The Secretary of Natural Resources is responsible for conservation management of the fish, fisheries, fish resources, and aquatic life within Maryland. Before a person may remove or eradicate submerged aquatic vegetation from any land under the tidal waters of Maryland, the person must submit to DNR for approval a description of the activity. DNR shall establish a program to study the impact of recreational watercraft activities on submerged aquatic vegetation beds in the Chesapeake Bay and coastal bays. DNR shall prepare fishery management plans for the listed species, and these plans must include the best available estimates of sustainable harvest rates, indicators that would trigger any changing of harvest restrictions, a description of the fishery, and other pertinent data. (Code, Nat. Res. §§4-201 to 4-216 (2002); COMAR 08.02.01.01 to 08.02.01.05 (2002))

### **Endangered Species of Fish Conservation Act**

Endangered or threatened species of fish within Maryland should be protected, and Maryland should also assist in the protection of federally designated threatened and endangered fish by prohibiting their taking, possession, transportation, exportation, processing, and sale. The Secretary of Natural Resources shall develop conservation programs to insure the continued ability of fish in need of conservation to perpetuate themselves successfully. These conservation programs may include acquisition of land or aquatic habitat or interest necessary for the conservation of threatened or endangered species of fish. (Code, Nat. Res. §§4-2A-01 to 4-2A-09 (2002); COMAR 08.02.12.01 to 08.02.12.02 (2002)).

### **Wildland and Open Areas**

The wildland and open areas statute authorizes any county, city, the Maryland-National Capital Park and Planning Commission, and the DNR to acquire or purchase interests or rights in real property for preservation of open spaces and areas. The wildland and open areas statute establishes a State wildlands preservation system composed of areas in Maryland designated by the General Assembly as “wildland areas.” A wildland is an area of land which has retained its wilderness character or has a rare species of plant or animal. Any State wildland area must be managed so as to preserve its wildland character. Any area that was open to hunting, fishing, or trapping prior to wildlands designation shall continue to be available for those activities. (Code, Nat. Res. §§5-1201 to 5-1219 (2002); COMAR 08.01.02.01 to 08.01.02.06 (2002))

### **Chesapeake Bay and Atlantic Coastal Bays Critical Area**

This statute creates a program to guide development in the Chesapeake Bay Critical Area and the Atlantic Coastal Bays Critical Area and creates a commission, the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, to oversee the program. Each local jurisdiction shall have primary responsibility for developing and implementing a program, which must consist of at least a map designating the critical area in a local

jurisdiction; a comprehensive zoning map for the critical area; new or amended subdivision regulations, comprehensive or master plan, zoning ordinances or regulations, enforcement provisions, and development grandfathering provisions; provisions to limit the amount of land covered by impervious surfaces; establishment of buffer areas along shorelines; requirements for minimum setbacks for structures and septic fields along shorelines; designation of shoreline areas that are suitable for certain public uses; provisions requiring that all harvesting of timber in the Chesapeake Bay Critical Area or the Atlantic Coastal Bay Critical Area be in accordance with plans approved by the district forestry board; provisions for reasonable accommodations in policies or procedures when the accommodations are necessary to avoid discrimination on the basis of physical disability; and provisions for granting a variance to the local jurisdiction's critical area program. (Code, Nat. Res. §§8-1801 to 8-1817 (2002); COMAR 27.01.01.01 to 27.03.01.04 (2002))

### **Wildlife: Organization and Authority**

The Secretary of Natural Resources is responsible for the conservation and management of wildlife and wildlife resources of Maryland. The Secretary shall develop and implement a comprehensive nutria management plan to eradicate nutria from Maryland. There is a Wildlife Advisory Commission in DNR. The Secretary may adopt regulations to enlarge or restrict hunting, possessing, selling, shipping, or exporting wildlife. DNR may reduce the wildlife population in any part of Maryland after an investigation reveals that protected wildlife is injurious to agricultural or other interests. (Code, Nat. Res. §§10-201 to 10-210 (2002))

### **Nongame and Endangered Species Conservation Act**

Threatened or endangered plants or animals within Maryland should be protected. Maryland should also assist in the protection of threatened or endangered species that are found on the federal list by prohibiting the taking, possession, transportation, exportation, or sale within Maryland of these species. The Secretary of Natural Resources shall establish programs necessary for the conservation of nongame, threatened, or endangered species of wildlife or plants. There is a Birdwatcher's Fund to be used for the preservation of nongame wildlife species and threatened and endangered species. (Code, Nat. Res. §§10-2A-01 to 10-2A-09 (2002); COMAR 08.03.08.01 to 08.03.08.13 (2002))

## **8.5.7.2 Maryland Department of the Environment (MDE)**

### **Powers, Duties and Enforcement**

The Department of the Environment (MDE) is the principle State department charged with regulation of the State's environmental laws, including those laws impacting air, noise, hazardous substances, radiation, waste, water resources, and water pollution within the State. (Code, Env. §§1-101 to 1-606 (2002); COMAR 26.01.01.01 to COMAR 26.01.07.12 (2002))

### **Nontidal Wetlands**

MDE regulates the use of nontidal wetlands, and MDE has a program for the conservation, regulation, enhancement, creation, monitoring, and wise use of nontidal wetlands. A wetlands permit is required for regulated activities in nontidal wetlands, but exemptions exist. A permit for a regulated activity in a nontidal wetland will not be granted unless it is a water dependant activity that requires access to the wetland but will minimize impairment, not cause degradation of the ground or surface water, and is consistent with management of nontidal wetlands. MDE lists those nontidal wetlands with a buffer of 100 feet. If a permit applicant cannot avoid wetlands loss, MDE shall require mitigation measures according to mitigation standards. Mitigation includes monetary wetlands creation, restoration, enhancement, or monetary compensation. (Code, Env. §§5-901 to 5-911 (2002); COMAR 26.23.01.02 to 26.23.06.03 (2002))

### **Water Pollution Control**

MDE regulates the quality of the State's water and discharges to State waters. As such the State classifies State waters depending on the uses available for those waters. MDE may also set water quality standards for State waters in order to protect public health and safety and to ensure the continued use of State waters for recreation, agriculture, industry, and all other legitimate uses. The State has an anti-degradation policy for its State waters and has set criteria for its surface waters to protect against any degradation. Discharge permits are required for any discharge of pollutants to State waters. MDE lists the numerous prohibited discharges to State waters, but MDE shall allow certain discharges that meet Department standards and conditions. Each discharge permit shall specify average and maximum daily quantitative limits in terms of weight for the discharge of pollutants in the authorized discharge. MDE can include other conditions and requirements in discharge permits in order to protect public health and the environment and to ensure water quality standards. MDE shall adopt toxic substance criteria for any substance that MDE determines could reasonably be expected to interfere with designated uses. MDE has specific regulatory authority over publicly owned treatment works, sewage facilities, chlorine discharge, marinas, and underground injection. MDE also monitors the water quality of State waters and, specifically, the Chesapeake Bay. (Code, Env. §§9-301 to 9-351; COMAR 26.08.01 to 26.08.04.11; COMAR 26.08.07.01 to 26.08.09.07; COMAR 26.03.06.01 to 26.03.06.13; COMAR 26.03.08.01 to 26.03.08.07; COMAR 26.04.05.01 to 26.04.05.03 (2002))

### **State Wetlands**

It is the public policy of the State to preserve the wetlands and prevent their despoilation and destruction, taking into account the various ecological, economic, developmental, recreational, and aesthetic values. Maryland's wetlands are divided into two categories: State owned and privately owned. State wetlands are those lands under the navigable waters of the State below the mean high tide line that are affected by the regular rise and fall of the tide. However, all such wetlands that have been transferred to private ownership by the State are considered private wetlands to the extent of the property interest transferred. Private wetlands also include any land not considered State wetland bordering on or lying beneath tidal waters, which is subject to regular or periodic tidal action and supports aquatic growth and tidal waters created by the excavation of upland unless conveyed to the State. (Code, Env. §§16-101 to 16-205)

### **8.5.7.3 Maryland Department of Housing and Community Development**

#### **Maryland Historical Trust**

The Maryland Historical Trust is part of the Department of Housing and Community Development and was created to preserve sites significant in the history and culture of Maryland and to encourage others to do so. The trust may provide grants and loans for the acquisition, rehabilitation, and restoration of historic property. All submerged archaeological historic property located on or recovered from submerged lands over which the State has sovereign control is the property of the State. A person may not excavate or injure a submerged archaeological historic property on submerged lands over which the State has sovereign control without a permit from the trust. The issuance of permits will be under a program termed the Maryland Maritime Archeology Program. A person may not excavate or injure any terrestrial archaeological site on land the State owns without a permit from the trust. There is an Archaeology Office in the trust, which will include a State terrestrial archaeologist and a State underwater archaeologist. (Code, art. 83B, §§5-601 to 5-630 (2002); COMAR 05.08.01.01 to 05.08.03.17; COMAR 05.08.05.01 to 05.08.05.11 (2002))

All submerged archaeological historic property located on or recovered from submerged State controlled lands is the property of the State. Such submerged archaeological historic property is defined as sites, structures, objects, or remains which may yield significant scientific information. The Maryland Historical Trust was developed to preserve, protect, and enhance districts, sites, buildings, structures, and objects significant in the prehistory, history, upland and underwater archaeology, architecture, engineering, and culture of the State, to encourage others to do so and to promote interest in and study of such matters.

The Maryland Historical Trust established the Maryland Maritime Archaeology Program for the issuance and administration of permits for activities relating to submerged archaeological historic property. The regulations apply to submerged lands which have remained unclaimed for 100 years or more, and to sites eligible for or included on the National Register of Historic Places.

#### **8.5.8 Volunteer Programs**

Volunteers are a valuable resource to a National Estuarine Research Reserve. By providing help with the Reserve's protection, research, monitoring, education, and interpretation, volunteers contribute to the goals of the National Estuarine Reserve Research System and to the Reserve. Public awareness of the importance and value of estuaries is increased by establishing a far-reaching network of informed individuals. Volunteer programs foster a sense of stewardship and build community support for the Reserve.

Active volunteer programs exist at Jug Bay Wetlands Sanctuary and at Otter Point Creek. A similar program, although not as extensive, will be developed for Monie Bay. All CBNERR-MD staff will work with volunteers, but the Reserve Stewardship Coordinator

will have primary responsibility for coordinating with volunteers and volunteer groups.

#### **8.5.8.1 Otter Point Creek Volunteer Programs**

A volunteer program was established in conjunction with the Otter Point Creek Alliance and has grown steadily. A volunteer information sheet highlights the various jobs available. Each job has a written description. A Volunteer Manual, given to every volunteer, holds all pertinent information including job descriptions, expectations, and local natural and cultural history. Active volunteers (those who volunteer at least 10 times per year) are invited to participate in two to four field opportunities annually and to an annual Volunteer Appreciation dinner.

Volunteers are recruited mainly from public programs, but also from Harford County Community Services Volunteer Placement Programs. All volunteers receive some training with specific training sessions provided to those with specialty jobs, such as canoe and animal care volunteers. All hours are tracked in a volunteer log book and reported monthly to Harford County Parks and Recreation and quarterly to DNR. Typical volunteer jobs are canoeing, animal care, front desk work or research/monitoring. Other volunteers edit the newsletter, photograph events or assist with lab programs.

The Otter Point Creek Alliance is a nonprofit support organization that has a volunteer Board of Directors. People serving on this board are normally active volunteers and/or frequent program participants. The board meets bi-monthly and serves as an advisory group for the component.

The Reserve's future plans for volunteer development at Otter Point Creek include several enhancements:

- Revision of the water quality monitoring program with better information given back to the participants.
- Expansion of the submerged aquatic vegetation program.
- More field trip opportunities for participants and additional opportunities for volunteers to network with volunteers from other sites. There is considerable interest from volunteers to learn more about the wild rice restoration project at Jug Bay.

#### **8.5.8.2 Jug Bay Volunteer Programs**

In Patuxent River Park, volunteers assist MNCPPC staff in many ways, but primarily they are used to supplement office staff. Volunteers also help with building the wild rice exclosures, harvesting seed, and planting seed in the spring. Recently, volunteers have helped plant submerged aquatic vegetation, done in partnership with the Chesapeake Bay Foundation, the Reserve, and DNR's Resource Assessment Service.

The Jug Bay Wetlands Sanctuary has a very active volunteer network with over 300 active individuals. Volunteers are an important resource for construction and maintenance of trails and boardwalks. Sanctuary staff manage and direct volunteer activities in cooperation with the Friends of Jug Bay. The following is a list of volunteer activities sponsored by Jug Bay and organized by category. Reserve staff assist with

some of these activities, especially those associated with monitoring programs.

- Research and Monitoring: water chemistry and nutrient dynamics; Invertebrates: stream monitoring; Plants: submerged aquatic vegetation, wild rice, habitat.
- Surveys: Fish Surveys; Amphibians: marbled salamander migration study; frog calling survey; herp search; Turtles: box turtle habitat and population study, red-bellied turtle nesting study, painted turtle study; Birds: MAPS; fall migrant study; water bird census; saw-whet owl census.
- Education Programs: Volunteer Naturalist; Canoe Guide; Public Events Assistant; Education Advisory Committee
- Trails and Grounds: Removal of invasive plants; scout and school service projects; trail maintenance and blazing; marsh clean up; sign making; boardwalk maintenance and building; planting trees and shrubs.
- Administrative: Visitor Center host; represent Jug Bay at various special events; Scientific Advisory Committee.

### **8.5.8.3 Monie Bay Volunteer Programs**

Overall, successful volunteer activity for the Reserve at Monie Bay is mostly focused on Wetlands and Wildlife Field Day. For example, parents and high school students volunteer during the two-day event to act as chaperones and mentors for the fourth-graders participating in the program.

In an effort to expand volunteer involvement in Monie Bay, a part-time volunteer coordinator was hired with Reserve Federal funds in 2002-2003. This person worked with the Site Manager to help build a volunteer base and program. The intent was to apply and adapt the successful models demonstrated by the Friends of Jug Bay and the Otter Point Alliance. Difficulties in engaging the local community in Reserve programs and other problems led the Reserve to step back to re-assess local opportunities including commissioning the Monie-Bay socio-cultural needs assessment (*Linking Estuarine Ecology and Community Heritage: A Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005).

Based on the findings of the socio-cultural needs assessment, the Reserve will work with the researchers who performed the assessment and interested local groups and individuals to develop a local partnership(s) to work with the Site Manager and the Reserve at Monie Bay. The purpose of the local partnership(s) will be to:

- Build on successful partnerships developed through Wetlands and Wildlife Field Day.
- Identify specific local interests that will blossom into active volunteer activities in partnership with the Reserve and site management that can simultaneously benefit all interests.
- Prioritize potential projects and programs that can involve volunteers in positions of responsibility that can work effectively to attain both the goals of the local community, the Reserve at Monie Bay and site management at the Monie Bay and Deal Island WMA.
- Help determine the appropriate form and extent of Reserve investment in building and maintaining a Monie Bay volunteer program. Reserve investment may include

funding projects and hiring staff.

- Pursue selected projects and programs that will meet immediate interests/needs and contribute to building a continuing volunteer organization and/or network.

## **8.6 Key Partners**

The Stewardship Coordinator will establish a working relationship with county governments and their Planning and Zoning Departments, Parks and Recreation Departments, and Public Works Departments in order to determine strategies for acquisitions.

Key partners for restoration activities include:

- Harford County Parks and Recreation
- The Izaak Walton League of America, Harford County Chapter
- Anne Arundel County Department of Recreation and Parks
- Maryland-National Capital Park and Planning Commission (M-NCPPC), Department of Parks and Recreation
- Maryland Department of Natural Resources
- Friends of Jug Bay
- Otter Point Creek Alliance

To augment and develop volunteer programs, the Stewardship Coordinator will develop partnerships, as appropriate, with county school systems, Maryland Conservation Corps, scouting, 4-H, and other community groups, places of worship, and other community organizations.

## **8.7 Future Directions**

The Stewardship Coordinator will work with volunteers and friends' groups, who serve as the eyes and ears of the Reserve, and with site staff and county partners to stay apprised of activities that may impact the Reserve. A Land Acquisition and Protection Plan identifying parcels for consideration for acquisition or easements will be developed and updated annually.

To protect the ecological integrity of the Reserve, existing environmental and zoning regulations must be stringently enforced, stormwater and sediment control facilities must be maintained, and the proper environmental control characteristics must be incorporated into development plans and designs. The proper enforcing agents must work to ensure that there is no change in the quality or quantity of the water entering the Reserve due to development in the watershed. The CBNERR-MD Stewardship Coordinator will work to ensure that this is accomplished.

Restoration and volunteer sampling projects will be implemented with assistance from volunteers, according to the needs at each component. A volunteer program at Monie Bay will be developed (as described above in Section 8.8.3).



## 9. PUBLIC ACCESS

### 9.1 Introduction

Providing public access to Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) is important to building support for the Reserve and fostering a connection to—and a sense of stewardship of—the Chesapeake Bay. At the same time, controlling public access is important to protect the Reserve, particularly core areas, so that they can function as reference sites for research and education programs. A sound public access policy will help achieve the goals of the National Estuarine Research Reserve System (NERRS), CBNERR-MD, and the Maryland Department of Natural Resources (DNR).

### 9.2 Chesapeake Bay Context

Public access to the Chesapeake Bay and its tributaries provides opportunities for boating, fishing, swimming, and nature watching. Access is provided through a variety of boat and canoe/kayak launching sites, parks, and beaches. The Chesapeake Bay Program's *Chesapeake Bay, Susquehanna River & Tidal Tributaries Public Access Guide* provides information on over 500 major public access sites in the Bay region.

### 9.3 CBNERR-MD Management Issues

CBNERR-MD management issues affect public access policies and challenges. Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

Population growth clearly affects public access to the Reserve. As local populations increase, there is increased use pressure, requiring well managed access control to ensure that visitorship is provided to foster stewardship while continuing to protect the resource. Climate change, particularly sea level rise, affects access points and infrastructure (such as boat ramps and docks) that over time may become non-functional due to rising sea level.

#### **9.4 CBNERR-MD Public Access Goals, Objectives, and Strategies**

### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

**Objective 1.3. The long-term integrity and diversity of Reserve habitats will be maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

Strategy: Control public access times and levels to protect the Reserve, particularly the core areas.

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Maintain existing and build new access infrastructure as needed to provide access for research activities, K-12 and public education programs, and coastal training programs.

- Acquire appropriate suitable property with both road and deep water access at Monie Bay and build or renovate needed access infrastructure (e.g., road, boat ramp).
- Build additional trails, boardwalks, and overlooks at Otter Point Creek and Jug Bay.

### **GOAL 3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect Maryland's coastal communities and ecosystems.**

**Objective 3.5. Local communities and local governments will have a higher level of support for estuarine and coastal stewardship.**

Strategy: Maintain existing and build new access infrastructure as needed to provide access for K-12 and public education programs and coastal training programs.

- Acquire appropriate suitable property with both road and deep water access at Monie Bay and build or renovate needed access infrastructure (e.g., road, boat ramp).
- Build additional trails, boardwalks, and overlooks at Otter Point Creek and Jug Bay.

## **9.5 Public Access at CBNERR-MD**

Public access for CBNERR-MD varies at the different components and at different areas within each component. Access is provided for research, education, and coastal training programs, and limited access is also provided for unprogrammed public use in buffer areas. CBNERR-MD DNR staff work closely with site staff and local partners to limit access to core areas of each component. Access is described separately for each component below.

### **9.5.1 Otter Point Creek Public Access**

At Otter Point Creek, public access is managed and planned by the two property owners consistent with the goals and objectives of the Reserve. Access to the resource is provided through a boat ramp at Leight Park and trails at the Park and at Bosely Conservancy. There is difficult access into the marsh itself for programming due to the lack of sufficient boardwalks. Due to dense population in the area, controlling access is a challenge.

#### **9.5.1.1 Bosely Conservancy**

The Melvin G. Bosely Wildlife Conservancy, which is the western portion of Otter Point Creek, can be reached from Route 40 via Edgewood Road, Hanson Road, and Perry Avenue.

The Harford County Chapter of the Izaak Walton League of America (IWLA) has a limited access policy in effect for the Melvin G. Bosely Wildlife Conservancy. Public access is limited from dawn to dusk and confined to marked trails. These trails are built and maintained by the Izaak Walton League and Harford County Parks and Recreation staff. IWLA also conducts hunter safety courses and marsh clean-ups and assists the Reserve with canoe trips and school programs. The Reserve conducts canoe trips, hikes, clean-ups, and other educational and research activities at the Bosely Conservancy year-round.

The IWLA allows sport fishing, hunting and trapping in the Conservancy by permission only. Currently, the IWLA is operating a waterfowl management program. The program provides for habitat improvement and nesting facilities for mallard and wood duck species.

Prosecution of violators serves as a deterrent against illegal hunting, illegal driving of off-road vehicles, vandalism, and littering. IWLA solicits retribution through the court's community service program and will continue this enforcement policy. None-the-less, vandalism and improper uses remain an issue at this location.

#### **9.5.1.2 Leight Park**

Leight Park, which is the northeastern portion of the Otter Point Creek component, can be reached by taking Otter Point Road south from Route 40. This road leads to the parking lot and Estuary Center and also leads to Otter Point Landing. There is also an access

point to the component from newly acquired property directly on Route 40 just north of the State Highways Administration's small park.

The portion of Leight Park that has been in the Otter Point Creek component of the Reserve since 1990 is the former Leight property, which was donated to Harford County for use as a "passive use" park. Consistent with the intent of this donation, the majority of this county-owned park is used for passive recreation, research, and educational programs.

The majority of visitor use is concentrated at the Anita C. Leight Estuary Center. Use of the Estuary Center focuses on activities related to natural environment and resources and cultural history of the property/vicinity. It can be used by public and private schools in Harford County for research and education programs for students and teachers. Use of the Estuary Center also includes walk-in visitation available to the general public, as well as educational and crafts workshops and programs that are open to a variety of groups and individuals.

### **9.5.1.3 Open Water**

Access to open water in the Otter Point Creek component of the Reserve is limited by accessibility from land and by intermittent shallow water caused by tidal flux. Even though there are no restrictions to boats entering the component from open water, the natural limitations of the area appear to prevent boating related problems.

Otter Point Landing (just east of Leight Park) contains a county maintained boat ramp for public use. The ramp is open from April through October (6 a.m. to 9 p.m.) and is closed from November through March. Additional parking facilities for cars and trailers are provided. Small, hand-carried boats can also be launched from the State Highway's Smith Park, which is located between the site boundary and Route 40.

Recreational boating and fishing are popular activities in the Bush River and Otter Point Creek area. Shellfish harvesting is prohibited in these areas because the limited amount of harvestable resource present is too small to warrant the State bacteriological monitoring that would be necessary to verify safe (or unhealthy) levels of pathogens.

The Chesapeake Bay Foundation (CBF) conducts three to four environmental education canoe trips in Otter Point Creek each year for Harford County junior high and high school science classes. Harford Glen Environmental Education Center also conducts four to six canoe trips each year for high school students.

### **9.5.2 Jug Bay Public Access**

At Jug Bay, public access is managed and planned by the two property owners (Anne Arundel County and MNCPPC) consistent with the goals and objectives of the Reserve. Good access to the resource for programming is provided by trails, boardwalks, overlooks and docks. Gated roads and the rural nature of the area help to control access.

### **9.5.2.1 Patuxent River Park**

The portion of the Patuxent River Park in and around the Reserve, the Jug Bay Natural Area, is a "limited use" natural area. Park hours are 8 a.m. to dusk and most of the park is secured at night. Advance reservations are required for groups, and group sizes are limited to maintain an optimum staff-to-visitor ratio. Individual visitors are required to obtain a daily or annual special-use permit from the park office. Activities having a negative impact on the environment are prohibited.

The goals of the Park are to protect the area's natural and scenic values, while providing for limited public use, natural history interpretation, environmental education and other activities consistent with the Wild and Scenic Rivers Act. Park personnel conduct interpretive boat tours on the river. Living history tours are conducted at historical sites in upland areas near the area designated as the Reserve. Patuxent River Park also has college work/study and internship programs. Upland areas of the park outside the Reserve site are used for education and interpretation facilities, historical sites, horse and foot trails, a 4-H center and camp, a Girl Scout camping area, an agricultural preservation area, and an Izaak Walton League hunting and fishing recreation area. These uses are compatible with and will help buffer the reserve.

Hunting with a special permit and horseback riding are allowed in designated upland areas of the Patuxent River Park with advance reservations.

### **9.5.2.2 Jug Bay Wetlands Sanctuary**

In an effort to preserve the unique and fragile environment and allow for ongoing research, the Jug Bay Wetlands Sanctuary in Anne Arundel County has been designated as a limited access facility. The site is open to the public from 9 a.m. to 5 p.m. on Wednesday, Saturday and Sunday, but is closed on Sundays from December through February. Visitors to the Sanctuary are charged a nominal entrance fee. Friends of Jug Bay exist to support the Sanctuary's education and research programs. Researchers and members of the Friends of Jug Bay may visit free of charge. All groups and individuals must make a reservation in advance of their visits.

### **9.5.2.3 Open Water**

Jug Bay waterways currently serve as recreational areas for boaters and anglers. Water skiing occurs infrequently due to the shallowness of the area. Fishing from the Patuxent River Park is permitted with a special-use permit only. Fishing is not permitted from the Jug Bay Wetlands Sanctuary. Sanctuary volunteers and naturalists lead "marsh ecology" canoe trips for groups from April through October. The Sanctuary also operates a public canoe and kayak launching site at Patuxent Wetland Park at Hills Bridge (Route 4), at Wayson's Corner.

Access to open water in the Reserve is limited by accessibility from land. Patuxent River Park maintains a boat ramp for access to Jug Bay. The Park Manager considers natural resource protection, park operational needs and public interests in the operation of the ramp.

### **9.5.3 Monie Bay Public Access**

There is no easy access to the Reserve. The best access is by boat, and the nearest boat ramp is a 20-minute to half-hour boat ride from the Reserve.

#### **9.5.3.1 Deal Island Wildlife Management Area (DIWMA)**

The Deal Island Wildlife Management Area (DIWMA), including the area designated as the Monie Bay component of the Reserve, provides public access for recreational uses such as hunting, trapping, fishing, and boating, as well as non-consumptive activities such as bird watching, wildlife photography and hiking. Other activities at the DIWMA include berry and asparagus picking.

There is no user fee or check in system for the DIWMA, so visitation estimates are not available. However, visitor use in the Monie Bay component itself beyond wildlife-related recreation (e.g., hunting) is minimal due to its remoteness and lack of easy access. The overall level of visitation that is occurring is consistent with long term resource protection. Based on current trends in visitation, some increase in the number of non-consumptive uses may be anticipated. A stable number of hunters and fishermen is also anticipated in the foreseeable future.

The top priority at Monie Bay will be to acquire property abutting both a road and deep water to provide suitable access for CBNERR-MD programs, and to build appropriate on-site facilities and infrastructure. In addition, additional staff and volunteers are needed to support access.

#### **9.5.3.2 Open Water**

The remote location of Monie Bay tends to limit public access via open water. There is no boat ramp within the Reserve at Monie Bay. The closest boat ramp is at Dames Quarter, which is a good 20 minute to half-hour boat ride to the Reserve.

Although Monie Bay is up to two meters deep, it is not popular for recreational boating. The low marshy topography of the surrounding bay makes it difficult to anchor and the area is prone to large mosquito and deer fly populations in summer and early fall.

Enforcement of Maryland boating regulations is conducted by DNR's Natural Resources Police. Additional management emphasis in the Reserve at Monie Bay is not necessary for open water areas.

### **9.6 Key Partners**

Key partners in setting and enforcing access policies are Site Managers, other site staff and associated State and county agencies, the Izaak Walton League of America, and DNR's Natural Resources Police.

## **9.7 Future Directions**

At Otter Point Creek and Jug Bay, public access issues will continually be evaluated to ensure that the maximum appropriate access is provided to foster stewardship and educate citizens and decision-makers about estuarine science, while protecting the Reserve, particularly its core areas. At these sites, there is already a good access infrastructure, which will be further improved by adding trails, boardwalks, and overlooks. The priority looking to the future is to control and direct access (particularly at Otter Point Creek), due to high and growing human population densities and use pressure.

There is currently no suitable access to the Monie Bay component. This lack of access cripples the ability to run programs at this site. The top priority at Monie Bay will be to acquire property abutting both a road and deep water to provide suitable access for programs.



## **10. BOUNDARY EXPANSION AND LAND ACQUISITION**

### **10.1 Introduction**

To achieve its mission, the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve) must protect the Reserve lands and waters in perpetuity to serve as reference areas and living laboratories for research and classrooms for education programs. In addition, suitable facilities, infrastructure, staging areas, and access to the resource are needed to support research, education, coastal training, and stewardship programs. Land acquisition and protection, and boundary expansion, will help achieve the goals of the National Estuarine Research Reserve System (NERRS) and the Maryland Department of Natural Resources (DNR), as well as those of CBNERR-MD,

This chapter discusses the current boundary expansions that will become effective upon approval of this plan, as well as future plans for boundary expansions and land acquisitions.

### **10.2 Chesapeake Bay Context: Land Acquisition**

A wide variety of federal, State, county, municipal, and private entities protect land in Maryland. CBNERR-MD is different from many of these entities in that the lands and waters protected by CBNERR-MD are done so with the concerted purpose of using these lands as reference sites and for research, education, and coastal training programs that translate sound science into wise decisions. Federal, State, and private programs can provide funding to help CBNERR-MD acquire land, such as the Coastal and Estuarine Land Conservation Program (CELCP), NERRS acquisition and construction program, and Maryland's Program Open Space. Private land trusts, such as The Conservation Fund, can provide assistance in the process of land acquisition.

### **10.3 CBNERR-MD Management Issues**

Following are the CBNERR-MD primary management issues. Protected lands and waters are essential to serve as reference sites to understand the impacts on estuarine systems of coastal decisions and management actions, as well as natural phenomena, and to understand the effectiveness of mitigations actions.

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.

- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

CBNERR-MD will address these stressors by striving to protect the Reserve areas through land acquisitions in an effort to acquire parcels that border the Reserve areas, parcels that encompass tributaries that empty into the Reserve areas, and parcels of concern, in order to prevent these lands from being degraded. These acquisitions will be acquired using Maryland’s Green Infrastructure Assessment (GIA) and other tools to determine the most sensitive areas, and to help to rebuild the fragile hubs and corridors.

To address the climate change stressor, CBNERR-MD will target acquisition of wetlands, as well as undeveloped uplands in low elevations adjacent to those wetlands, to allow the uphill migration of marsh and wetland areas (marsh creep) with impending sea-level rise.

#### **10.4 CBNERR-MD Land Acquisition Goals, Objectives, and Strategies**

Land acquisition is needed to fulfill the CBNERR-MD mission. The Reserve’s mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders. Land must be acquired to:

- Provide access and facilities for research, education, and coastal training programs.
- Protect the Reserve from outside impacts.

The following is a set of objectives and strategies identified as part of the Reserve land acquisition, for which the Reserve Manager and Stewardship Coordinator have primary responsibility, working together with site staff and other CBNERR-MD DNR staff. These objectives and strategies support CBNERR-MD Goal One.

### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

#### **Objective 1.3. The long-term integrity and diversity of Reserve habitats will be maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

Strategy: Explore opportunities for acquiring or protecting additional property to include within the Reserve.

- Complete and update Land Acquisition Plan.
- Implement Land Acquisition Plan.
- Apply for CELCP, NERRS Construction and Acquisition, and Program Open Space (POS) funding as appropriate.
- Work with partners (e.g., counties) to leverage other funding sources (e.g., county POS funding).
- Acquire properties to serve as key buffer areas adjacent to and upstream of all three Reserve components as described in the Land Acquisition Plan (in development).

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Acquire additional property and provide needed facilities within the Reserve for staging research, education, and community programs.

- Acquire suitable property with road access, water access, and high ground suitable for Research/Education/Cultural Visitor Center and other needed facilities at Monie Bay (where there are currently no facilities). Use CELCP, NERRS Construction and Acquisition, and Program Open Space (POS) funding as appropriate.

## **10.5 Land Acquisition Approach and Boundary Expansion**

Within CBNERR-MD, there are five entities that have a capability to interact with neighboring property owners, to manage and to acquire land:

- Maryland Department of Natural Resources (multiple divisions and programs)
- Anne Arundel County Department of Recreation and Parks
- Harford County Parks and Recreation Department
- Maryland-National Capital Park and Planning Commission Department of Parks and Recreation
- Izaak Walton League of America, Harford County Chapter

Each of these entities acts independently to meet land acquisition interests within their jurisdiction and interests. In addition, they may act in partnership with one another and/or in partnership with the State and NOAA to meet the interests of the Reserve. This chapter addresses only their Reserve-related acquisition activities.

### **10.5.1 General Approach to Land Acquisition**

In general, protection of natural resources and acquisition of land interests beyond the existing boundaries of the Reserve relies on willing cooperators. Consequently, action on these issues is necessarily opportunistic and varies greatly depending upon the interests of local property owners. Such opportunities include:

- Providing educational opportunities to property owners who wish to improve stewardship of their properties.

- Cooperating with neighboring property owners on management issues of mutual interest.
- Supporting donation or purchase of conservation or agricultural easements on land that will remain in private ownership.
- Acquiring properties in fee simple to augment existing public ownership.

While the list of potential opportunities may offer a great diversity of future activities and projects, all three components of the Reserve are in watersheds and estuary systems that are far too large to extend complete protection. Additionally, available funding will support only the most important, targeted protection and acquisition efforts. Therefore, it is beneficial to set priorities for potential protection and acquisition activities.

The priorities for the Reserve land acquisition are grouped based on facility, infrastructure, program needs associated with the Reserve or natural resource protection needs (7 and 8). They will be applied consistent with the policies and goals listed below:

- Maryland Chesapeake Bay National Estuarine Research Reserve goals (see Chapter 3).
- National Estuarine Research Reserve System goals.
- Maryland's Green Infrastructure Assessment: A Comprehensive Strategy for Land Conservation and Restoration, 2003.
- Maryland's Land Conservation Programs, Protecting the Chesapeake Bay Watershed, December 2003.
- Maryland's Coastal and Estuarine Land Conservation Plan, June 2005.

The priorities listed for natural resource protection and for protection or enhancement of access/use capabilities will be used by the Reserve in several ways:

- To help assess land acquisition opportunities individually and collectively.
- To enhance consistency in decision-making.
- To inform decision-making on the appropriate form of acquisition (easement, fee simple, other forms of acquisition or no acquisition at all).
- To help justify requests for federal funding.

<b>Table 7. CBNERR-MD Land Acquisition Priorities to Enhance Access/Utility (top priority at Monie Bay and top priority Reserve-wide for next five years)</b>	
1	Access points and sites to support Reserve research and monitoring
2	Use areas necessary to support Reserve education programs consistent with natural resource protection/management needs

<b>Table 8. CBNERR-MD Land Acquisition Priorities for Natural Resource Protection (top priority at Jug Bay and Otter Point Creek)</b>	
1	Green Infrastructure Hubs and Corridors adjacent to Reserve (see Figures 10 to 12)
2	Local ecological estuarine unit including wetlands and an appropriate buffer of land and open water
3	Tributary stream riparian/buffer areas. For tributary streams that are entirely within

	locally small watersheds, protection of the entire watershed may be appropriate. For Priority 2 and 3, the extent of an appropriate buffer may be estimated in consideration of floodplains, local hydrology, steep slopes, hydric or highly erodable soils, habitat requirements of locally important species or other potential measures of buffer needs
4	Completion of a contiguous, uninterrupted, protected natural resource area (such as a marsh or other wetland) that inherently lends itself to long-term site protection and management needs of the Reserve. The extent of this area may be estimated using Maryland's Green Infrastructure analysis, DNR's Natural Heritage Sensitive Species Project Review Areas, and/or other approaches to determining high quality natural resource areas and a protective buffer zone around them
5	Adjacent or upstream areas that, if restored, are likely to enhance the long-term viability of the Reserve core area (including undeveloped areas upland of marshes that may disappear due to erosion and sea level rise to allow for marsh migration)

### 10.5.2 Boundary Expansion

With the acceptance of this management plan, NOAA will approve the expansion of boundaries at Otter Point Creek and Jug Bay, as follows in Tables 9, 10, and 11.

Property/Area	Ownership	Acres 1990 Plan	Acres 2008 Plan
Bosely Wildlife Conservancy	IWLA, Harford Co. Chapter	350	350
Leight Park	Harford County	93	125
<b>Total Uplands and Wetlands Area</b>		<b>443</b>	<b>475</b>
Open Water	Waters of the State	261	261
<b>Total</b>		<b>704</b>	<b>736</b>

Property/Area	Ownership	Acres 1990 Plan	Acres 2008 Plan
Jug Bay Wetlands Sanctuary	Anne Arundel County	172	172
State lands at JBWS	State of Maryland	168	168
Glendening Nature Preserve	Anne Arundel County	--	610
River Farm	Anne Arundel County	--	280
Patuxent River Park Jug Bay Natural Area	MNCPPC	151	151
Patuxent River Park, Black Walnut Creek area	MNCPPC	--	455
<b>Total Uplands and Wetlands Area</b>		<b>491</b>	<b>1,836</b>
Open Water	Waters of the State	251	251
<b>Total</b>		<b>742</b>	<b>2,087</b>

Property/Area	Ownership	Acres 1990 Plan	Acres 2008 Plan (no change)
Portion Deal Island WL Mgmt Area	State of Maryland (DNR)	2,670	2,670
<b>Total Uplands and Wetlands Area</b>		<b>2,670</b>	<b>2,670</b>
Open Water	Waters of the State	756	756
<b>Total</b>		<b>3,426</b>	<b>3,426</b>

The State of Maryland and the relevant landowners have signed Memoranda of Understanding and conservation easements necessary to protect the new areas in perpetuity and manage them in a manner consistent with the goals of the Reserve and the NERRS. More details are provided in Chapter 8 (Stewardship), and copies of the MOUs and conservation easements for all properties are included in Appendices D, E, F, and G.

Otter Point Creek and Jug Bay will be expanded as described below. The Monie Bay component will not be expanded at this time.

#### **10.5.2.1 Otter Point Creek Boundary Expansion**

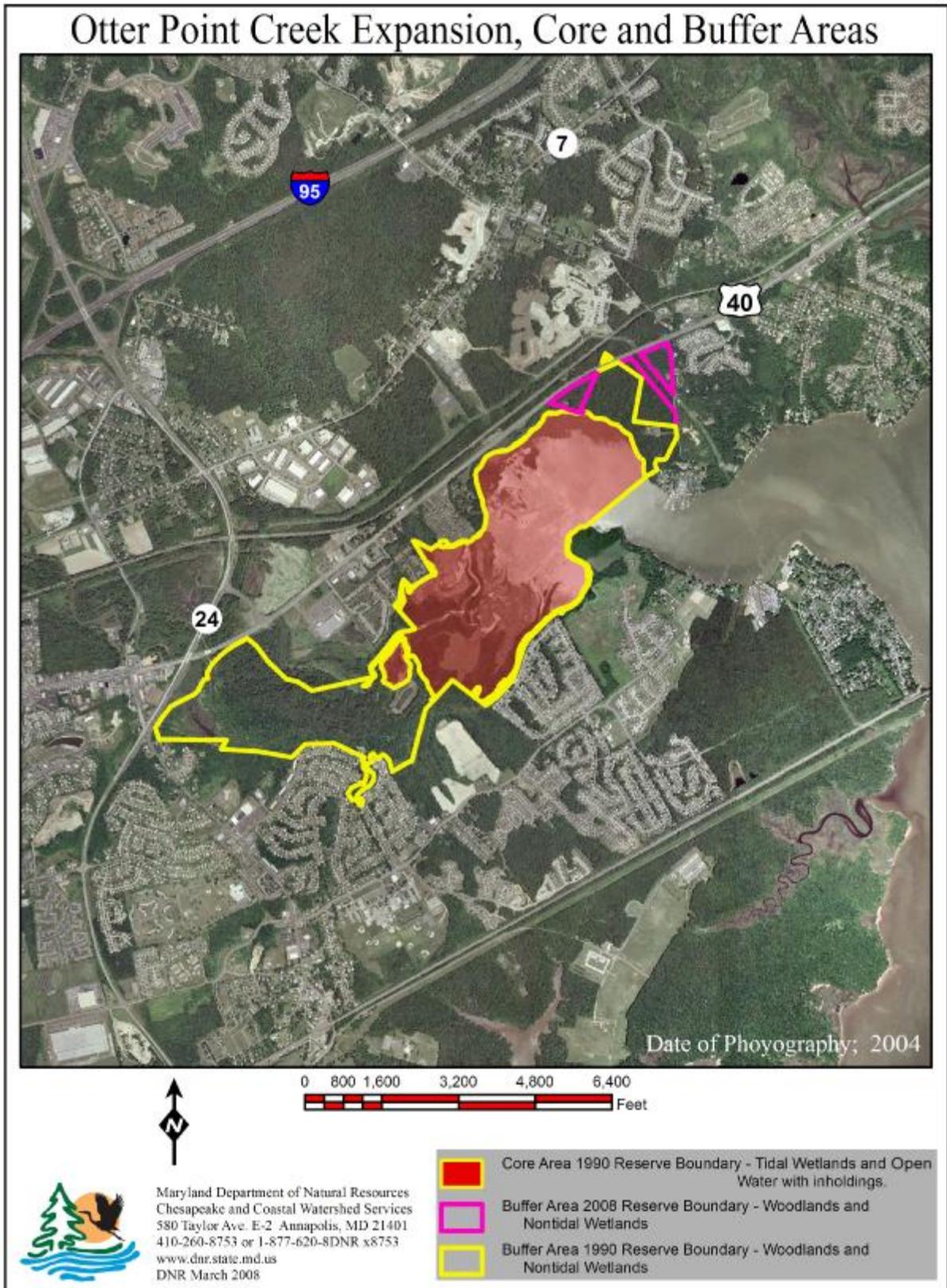
The Otter Point Creek component will expand its land area from 443 to 475 acres; its open water area will remain the same at 261 acres. The land increase consists of two parcels adjacent to the Otter Point Creek component that have been acquired by the Harford County Department of Recreation and Parks since approval of the 1990 Management Plan. The acreage of the Otter Point Creek component including both land and water areas will be 736 acres. The original and expanded areas are shown in Figure 7 (Otter Point Creek Expansion, Core and Buffer Areas). For a detailed ownership map, see Appendix M.

Harford County's Leight Park was expanded to incorporate an adjacent 32.1-acre parcel acquired in 2002 (former Hirshauer). Prior to this parcel becoming county property it was privately owned and had a couple of residences upon it. The parcel was purchased by the Harford County Land Trust to protect it in perpetuity and was subsequently incorporated into Leight Park. This acquisition is primarily mid-aged forest with a small section adjacent to Otter Point Creek. This land is also an integral part of the existing natural terrestrial buffer for the core estuarine area in the Reserve and serves as an access point for the monitoring of water quality and educational programming.

Management of this land is fully integrated into the Harford County management of Leight Park. It is already being used for research and education consistent with the rest of Leight Park and these programs will continue with the land's incorporation into the Reserve.

With the approval of this management plan it is the intent of Harford County, in cooperation with DNR and NOAA to incorporate this parcel into the Reserve.

# Otter Point Creek Expansion, Core and Buffer Areas



**Figure 7. Otter Point Creek Expansion, Core and Buffer Areas**

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### **10.5.2.2 Jug Bay Boundary Expansion**

The Jug Bay component will expand its land area from 491 to 1,836 acres; its open water area will remain the same at 251 acres. The acreage of the Jug Bay component including both land and water areas will be 2,087 acres.

In 1990 when the Jug Bay component of the Reserve was designated, its boundary encompassed a selected portion of the lands owned and managed by two different governmental entities. The area on the east side of the Patuxent River is owned by Anne Arundel County, and the area on the west side of the river in Prince George's County is owned by the Maryland-National Capital Park and Planning Commission (MNCPPC). (MNCPPC is a "bi-county agency empowered by the State of Maryland in 1927 to acquire, develop, maintain, and administer a regional system of parks in Montgomery and Prince George's Counties, and to prepare and administer a general plan for the physical development of the two counties.") Since 1990, both Anne Arundel County and MNCPPC have continued to manage land around the Jug Bay component of the Reserve and have acquired additional land in the vicinity. For a detailed ownership map, see Appendix M.

#### MNCPPC Boundary Expansion (Prince George's County)

MNCPPC will expand the boundary for the Jug Bay component by adding 455 acres of land already owned by MNCPPC. The goal of this expansion is to incorporate the entire watershed of Black Walnut Creek into the Research Reserve. This expansion would allow for the long term monitoring of water quality and habitat within the relatively undisturbed watershed and creek as well as offer numerous educational opportunities.

In 2007, an Addendum to the original Memorandum of Understanding (Appendix E.2) was signed between the Maryland Department of Natural Resources (DNR) and Maryland-National Capital Park and Planning Commission (MNCPPC) to expand the Jug Bay component to include lands already owned by MNCPPC. Land already in the component and land proposed for inclusion is shown in Figure 8 (Jug Bay Expansion, Core and Buffer Areas). The existing 151 acres of MNCPPC park land included in the Reserve in the 1990 management plan would be expanded by 455 acres of additional MNCPPC park land to a total of 606 acres. The county park land in the proposed expansion encompasses the Black Walnut Creek streambed and watershed, which is key for the protection of the creek, the wetlands that the creek feeds, and Jug Bay itself. This land is largely forested.

#### Jug Bay Wetlands Sanctuary Expansion (Anne Arundel County)

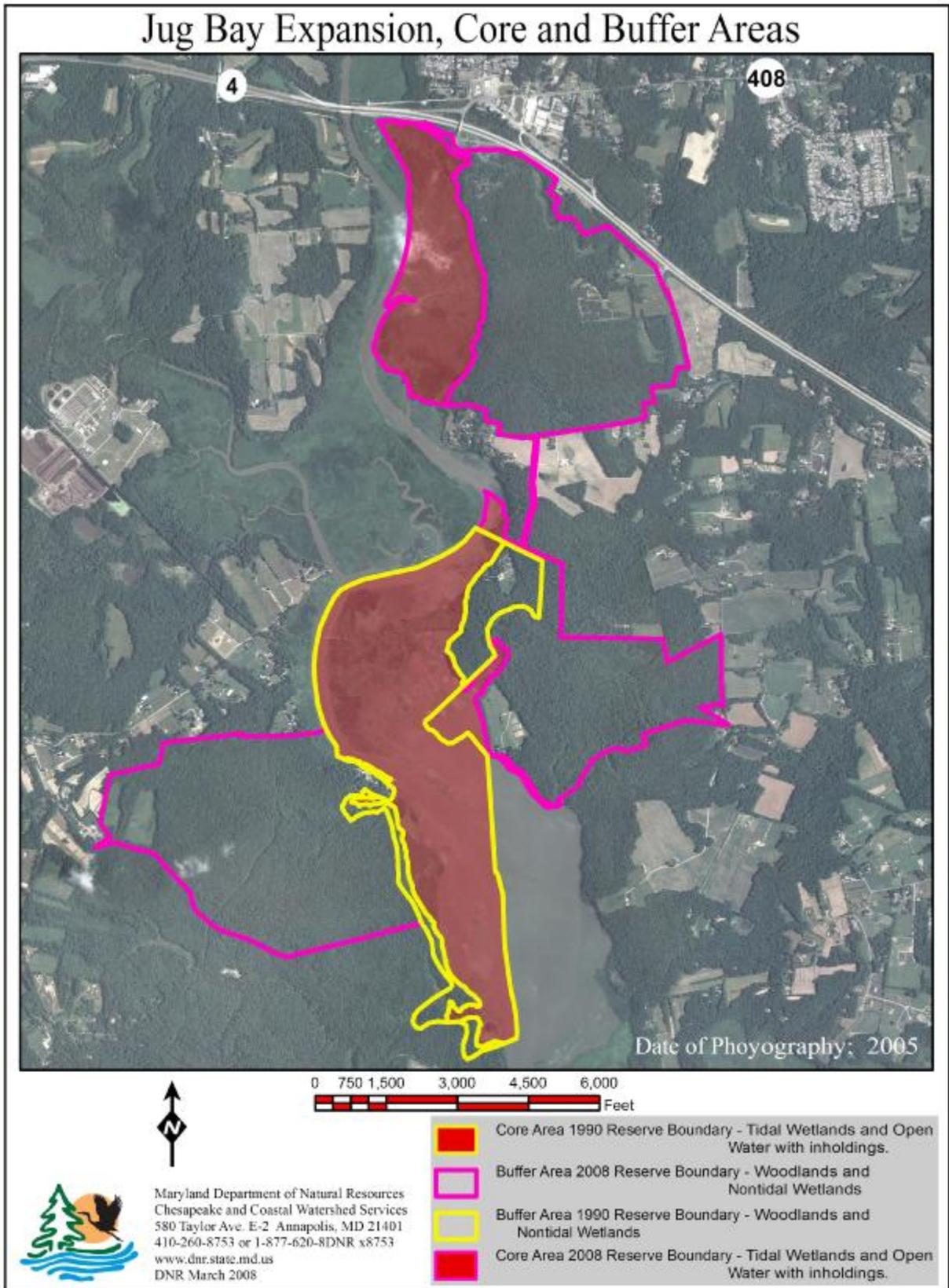
In 2006, an Addendum to the original Memorandum of Understanding (Appendix F.2) was signed between the Maryland Department of Natural Resources (DNR) and Anne Arundel County to expand the Jug Bay component to include lands that had been acquired by Anne Arundel County and incorporated into the Jug Bay Wetlands Sanctuary. Land already in the component and land proposed for inclusion is shown in Figure 8 (Jug Bay Expansion, Core and Buffer Areas). The existing 172 acres of county land included in the Reserve in the 1990 management plan would be expanded by 890

acres of additional Anne Arundel County park land to a total of 1,062 acres. The county park land in the proposed expansion encompasses core area (estuarine/wetland) and buffer area (wetland/terrestrial) that is important to the long term protection and use of the Reserve. This land was acquired in multiple purchases and is protected by a Memorandum of Understanding Addendum between Anne Arundel County and DNR, Covenants, a conservation easement (Appendices F.2, F.3, and F.4). The bulk of this expansion is the Glendening Preserve, comprised about a third of wetlands, over half of forested lands, and less than a sixth of formerly farmed, mowed or developed lands (near the Plummer House).

The Anne Arundel County park land is currently integrated into the management of the Jug Bay Wetland Sanctuary and the Reserve. It is in use for the same research and education purposes as the original Reserve area. Renovation/construction projects in progress and envisioned for this land are listed in the Chapter 11.

With approval of this management plan by NOAA, Anne Arundel County, and DNR intend that these 890 acres are to be incorporated into the Reserve Jug Bay component.

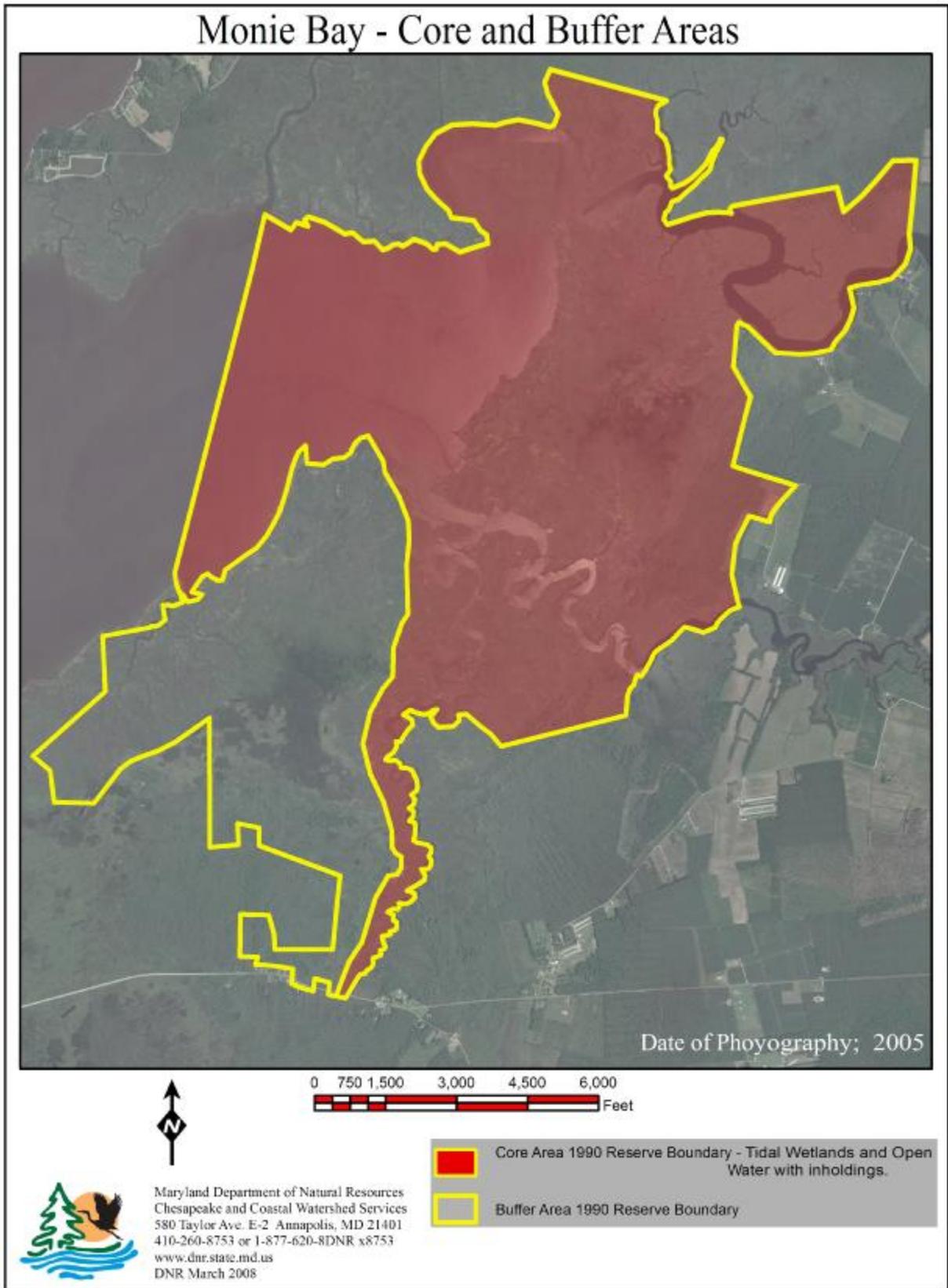
# Jug Bay Expansion, Core and Buffer Areas



**Figure 8. Jug Bay Expansion, Core and Buffer Areas**

### **10.5.2.3 Monie Bay Boundary Expansion**

No changes to the Monie Bay boundary are included in this plan. In 1985 when the Reserve at Monie Bay was originally designated, its boundary was established within the already existing Deal Island WMA. During the 20-year period 1985 through 2005, the existing Monie Bay component boundary within the Deal Island WMA has not changed. The boundary area is depicted in Figure 9 (Monie Bay Core and Buffer Areas). For a detailed ownership map, see Appendix M.



**Figure 9. Monie Bay Core and Buffer Areas**

## **10.6 Key Partners**

Key partners include local and national private land trusts (e.g., the Conservation Fund), Harford, Prince George's, Anne Arundel, and Somerset Counties, the Maryland-National Capital Park and Planning Commission, State programs (e.g., Program Open Space, Rural Legacy, Maryland Environmental Trust), and federal land acquisition programs (e.g., Coastal and Estuarine Land Conservation Program—CELCP, NERRS).

## **10.7 Future Directions for Boundary Expansions and Land Acquisitions**

Lands that are public owned and/or legally protected in perpetuity that are adjacent to the Reserve or in key watershed and upstream areas as identified in the Land Acquisition Plan will be considered for inclusion in the Reserve boundaries through boundary expansions. These expansions will be achieved through amendments to this plan or in the next management plan update (2013).

Land will be acquired and/or brought into protection (e.g., with conservation easements) for two reasons:

- To improve the utility of the Reserve at Monie Bay and the ability for research, education, and coastal training programming at this component.
- To improve the protection and integrity of the Reserve at all three components.

The primary focus of land acquisition efforts over the next five years will be to investigate and pursue possible opportunities for acquiring a property at the Monie Bay component for a Research/Education/Cultural Visitor Center and a staging ground for Reserve programs.

Additional acquisition efforts will involve efforts to protect priority lands in the vicinity of the Reserve components through conservation easements, agricultural easements, or direct property acquisition by the State or local partners from willing sellers. As described above, the Reserve will prioritize land acquisition based on the Reserve and NERRS goals, and will use tools such as Maryland's Green Infrastructure Assessment to help prioritize prospective areas.

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### 10.7.1 Otter Point Creek

In 2004, Harford County Department of Parks and Recreation acquired an approximately 45.5 acre parcel abutting the Bosely Conservancy on the southern boundary of the Otter Point Creek component. This parcel encompasses natural habitat (wetlands and forest) adjacent to the Reserve. This area is also an integral part of the existing natural terrestrial buffer for the core estuarine area in the Reserve. This parcel also includes open land that has potential to meet local recreational interests. Harford County has not determined its long-term management interests for this land. If Harford County decides to utilize this property in ways consistent with the Reserve's mission, a boundary expansion including this property may be considered in the future.

Based on ecological significance and Maryland's Green Infrastructure Assessment (GIA) to identify and rank high priority areas, CBNERR-MD will target parcels in Harford County that border the CBNERR-MD Otter Point Creek component site. See Figure 10 (Otter Point Creek - Targeted Protection Areas and Green Infrastructure). (The GIA is Maryland's extensive process for identifying key ecological hubs and corridors in need of protection. For more information on the GIA, go to: <http://www.dnr.State.md.us/greenways/greenprint/>.) The targeted parcels are lands identified by the GIA and, where possible, will be acquired from willing sellers or protected by easements to protect the Green Infrastructure from fragmentation and protect the CBNERR-MD from negative impacts.

In addition to property already acquired near the Otter Point Creek component, Harford County is exploring the potential for acquisition of additional properties in the watershed that drains to Otter Point Creek. If Harford County elects to seek expansion of the Otter Point Creek component boundary to incorporate parcels or portions of parcels that contribute to protection of the Otter Point Creek ecological unit, DNR will cooperate with the county in seeking NOAA approval for expanding the boundary to include those parcels.

No specific parcels or areas for future consideration will be named in this management plan. A number of areas were suggested orally at the public meetings held on February 20 and 21, 2007 and in writing during the comment period on this management plan. A copy of all comments is included in Appendix H. Additional parcels have been suggested in meetings associated with the ongoing development of the CBNERR-MD Land Acquisition Plan. Efforts will be made to evaluate the benefit to the Reserve of all suggested additions and the feasibility of appropriate additions. Refer to the most recent CBNERR-MD Land Acquisition Plan for information on parcels targeted for acquisition.



**Figure 10. Otter Point Creek - Targeted Protection Areas and Green Infrastructure**

### **10.7.2 Jug Bay**

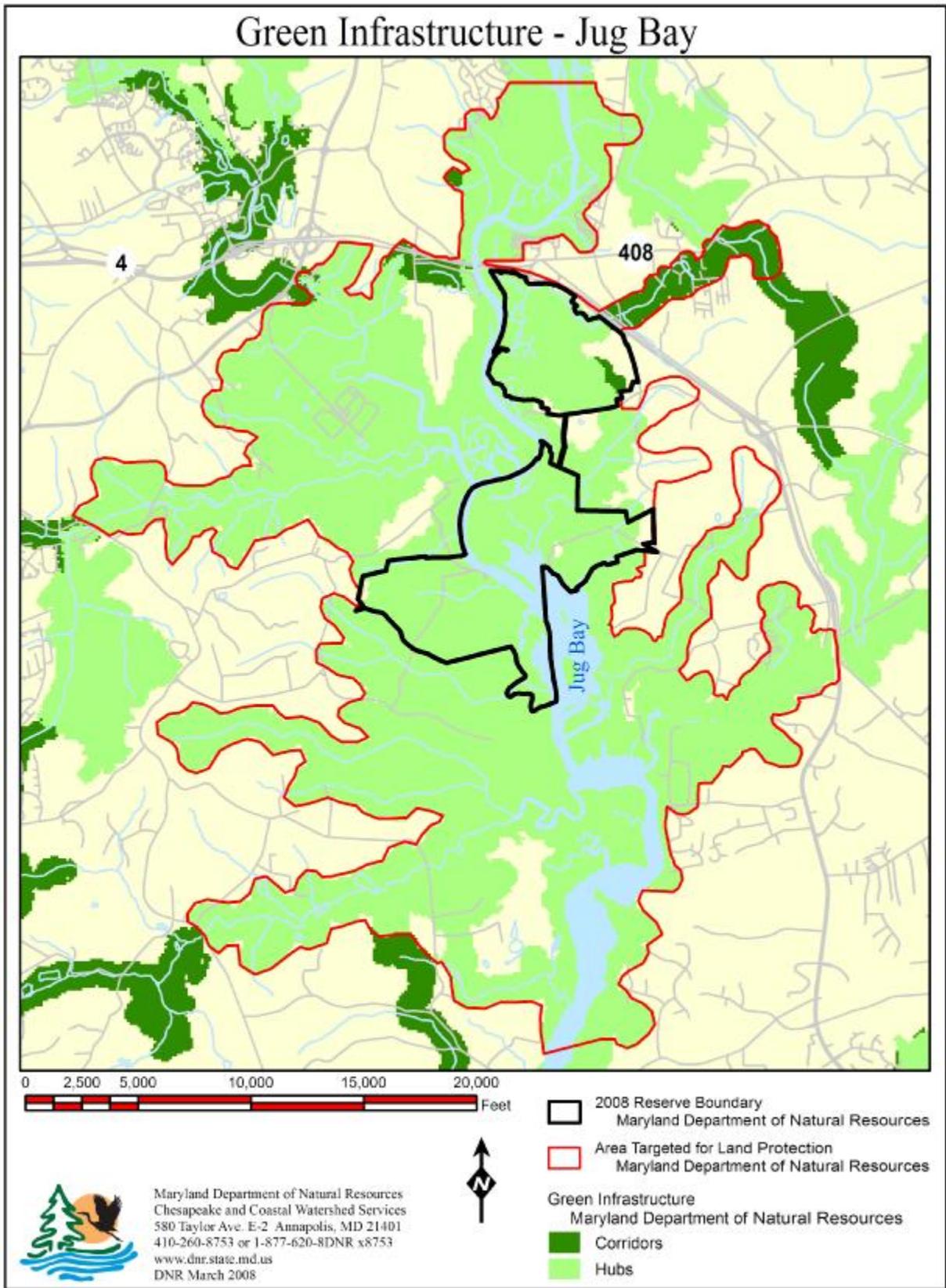
Reserve staff, in particular the Stewardship Coordinator, will stay apprised of conservation easements in the Reserve and Reserve watershed and any expiration dates. Reserve staff will work with partners in an effort to renew any expiring easements.

The 305-acre Riggleman Preserve was purchased in 2004 and incorporated into JBWS. This land will be incorporated into the Reserve during the next boundary expansion opportunity. Conversations will be initiated with State land managers (e.g., Merkle Wildlife Sanctuary) to discover any opportunities for program collaboration or for future inclusion in the Reserve.

Opportunities for land acquisition at Jug Bay will be pursued for additional appropriate areas that would contribute to the goals of the Reserve. For example, the possibility for purchase or conservation easement of key land parcels that border the Sanctuary will be examined when they come on the market. It will also be determined whether there are key private farmlands or other large properties that could be brought under conservation easement in order to contribute to Reserve goals. Adjacent properties key to protecting the Reserve may be considered for purchase by the State or county partners.

Based on ecological significance and Maryland's Green Infrastructure Assessment (GIA) to identify and rank high priority areas, CBNERR-MD will target parcels in Anne Arundel County and Prince George's County that border the CBNERR-MD Jug Bay component site. See Figure 11 (Jug Bay - Targeted Protection Areas and Green Infrastructure). (The GIA is Maryland's extensive process for identifying key ecological hubs and corridors in need of protection. For more information on the GIA, go to: <http://www.dnr.State.md.us/greenways/greenprint/>.) The targeted parcels are lands identified by the GIA and, where possible, will be acquired from willing sellers or protected by conservation easements to protect the Green Infrastructure from fragmentation and protect the CBNERR-MD from negative impacts.

No specific parcels or areas for future consideration will be named in this management plan. A number of areas were suggested orally at the public meetings held on February 20 and 21, 2007 and in writing during the comment period on this management plan. A copy of all comments is included in Appendix H. Additional parcels have been suggested in meetings associated with the ongoing development of the CBNERR-MD Land Acquisition Plan. Efforts will be made to evaluate the benefit to the Reserve of all suggested additions and the feasibility of appropriate additions. Refer to the most recent CBNERR-MD Land Acquisition Plan for information on parcels targeted for acquisition.



**Figure 11. Jug Bay - Targeted Protection Areas and Green Infrastructure**

### 10.7.3 Monie Bay

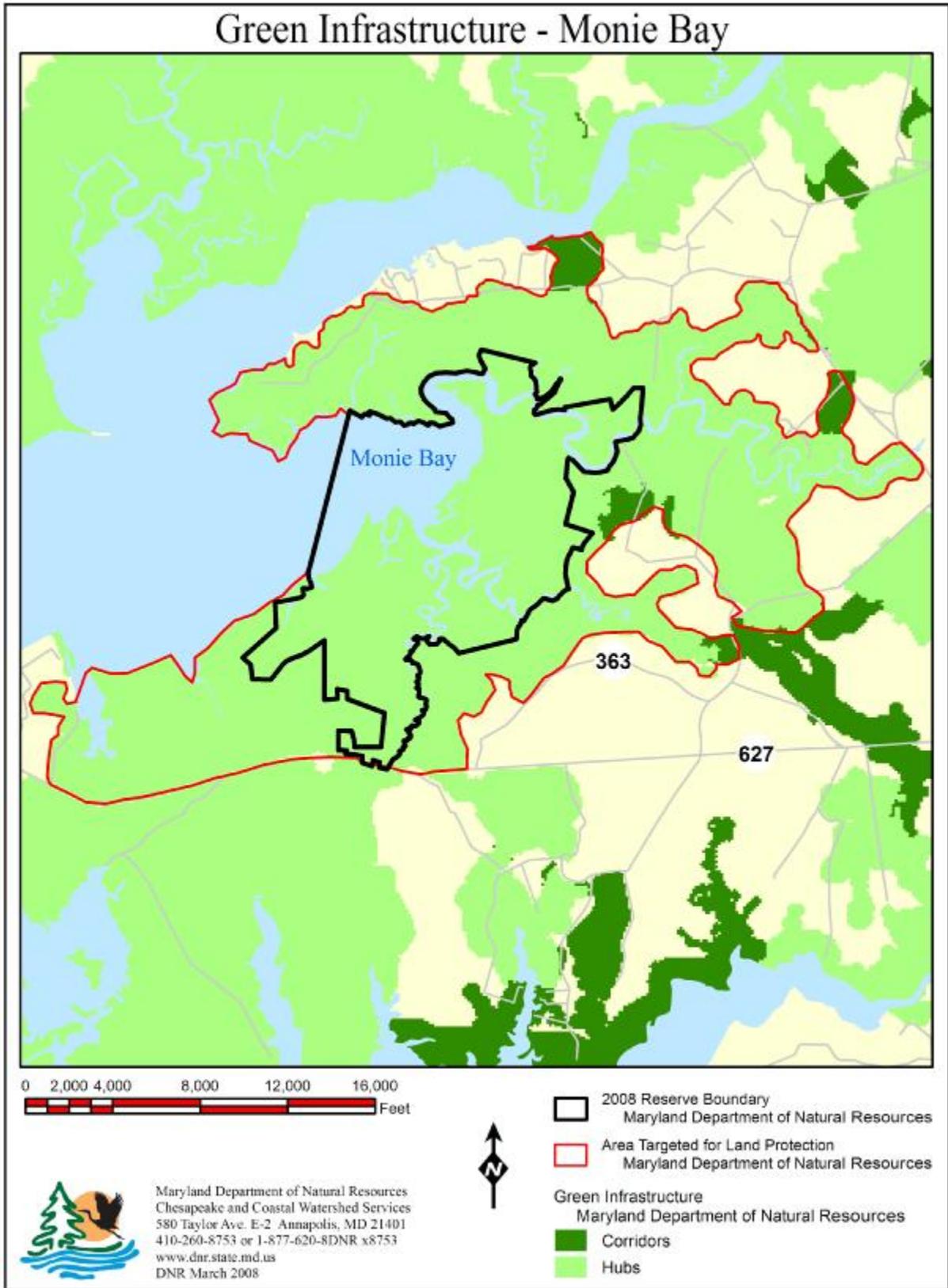
Since approval of the 1990 Management Plan for the Reserve, additional land has been acquired by DNR (parcel numbers 19, 26, and 44). Although not suitable for a Visitor Center, these lands are appropriate for the buffer area in the Reserve at Monie Bay and the potential for boundary expansion to include these properties will be pursued.

The primary focus of land acquisition efforts over the next five years will be to investigate and pursue possible opportunities for acquiring a property at the Monie Bay component for a Research/Education/Cultural Visitor Center and a staging ground for Reserve programs. This property would facilitate the increased use of the component for Reserve activities, such as education, research and stewardship, and would be incorporated into the Reserve.

Due to the current unavailability of a suitable site with road access, deep water access, and high ground suitable for a Visitor Center, this may take a two-step approach:

1. Acquire a property that can serve in the interim at a minimum as a staging ground for research and education programs. This site could ultimately be used as a research field station.
2. Continue to search for and acquire a suitable property with road access, deep water access, high ground, space for parking, etc. suitable for a Visitor Center.

Once a property for a Visitor Center is acquired, the focus will move to acquiring lands for protection. Areas targeted for land protection are show in Figure 12 (Monie Bay - Targeted Protection Areas and Green Infrastructure). (The GIA is Maryland's extensive process for identifying key ecological hubs and corridors in need of protection. For more information on the GIA, go to: <http://www.dnr.State.md.us/greenways/greenprint/>.) Refer to the most recent CBNERR-MD Land Acquisition Plan for information on parcels targeted for acquisition.



**Figure 12. Monie Bay - Targeted Protection Areas and Green Infrastructure**



## 11. FACILITIES AND EQUIPMENT

### 11.1 Introduction

To achieve its mission, CBNERR-MD must conduct estuarine stewardship, research, education and coastal training programs. To implement these programs, facilities are needed such as education/visitor centers, walking trails/boardwalks, overlooks, office space, bathrooms, research facilities, staging areas, storage facilities, and water access facilities, such as piers, docks and ramps. Exhibits and signs are needed to for education and outreach purposes. Vessels and vehicles are needed to conduct research and education programs.

### 11.2 Chesapeake Bay Context

The Reserve is situated at three locations in four counties in Maryland. In three of these counties, there are other large environmental education centers, which are associated with the county school systems:

- Harford County – Harford Glen
- Prince George’s County - Schmidt Outdoor Education Center
- Anne Arundel County – Arlington Echo

Somerset County, however, does not have any private or public environmental education centers. The Monie Bay socio-cultural needs assessment identified a strong need in Somerset County for a center.

“Without exception, informants expressed a need for a place or places to focus the communities’ and NERR-MD’s education and outreach efforts. This place(s) was most frequently expressed as some sort of museum or visitor center, either situated in one place or consisting of multiple sites. Residents were also quite open to ideas about where to situate such a museum or visitor center. The main concern was to find a piece of land where it would be possible to build something, and to do that soon, since property values are rising quickly.”  
(p. 65, *Linking Estuarine Ecology and Community Heritage: A Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005)

Therefore, providing facilities for programming at Monie Bay will be CBNERR-MD’s highest facilities construction priority over the next five years.

### 11.3 Chesapeake Bay Management Issues

The following CBNERR-MD management issues are the primary focus of CBNERR-MD programs. Facilities are needed to support these programs.

Five overarching management issues, associated with anthropogenic activities and natural impacts within the watershed, have been identified by the Reserve to affect all three sites at varying levels.

Two categories of key stressors require management actions to reduce their impacts on estuarine systems:

- Population growth and development, increases in impervious surface, the loss and alteration of habitat and vegetation in the watershed, and increases in point source flows.
- Climate change, subsidence, erosion, flooding and inundation, and the altering/hardening of shoreline structure.

Management actions will aim to help protect and restore:

- Sustainable living resource animal populations and communities (terrestrial and aquatic, including fish, reptiles, amphibians, birds, mammals and invertebrates).
- Important habitats including submerged aquatic vegetation (SAV – bay grasses), emergent plant, and native terrestrial plant communities.
- Healthy water quality/habitat.

These stressors and management issues will be considered in all facilities development. Facilities will be developed using Low-Impact Development, Environmental Design, and other green techniques to minimize impacts and to serve as a model for green facility development.

#### **11.4 CBNERR-MD Facility and Equipment Goals, Objectives, and Strategies**

Adequate facilities, equipment and infrastructure are needed to fulfill the CBNERR-MD mission. The Reserve's mission is to improve coastal resource management by increasing scientific understanding of estuarine systems and making estuarine research relevant, meaningful, and accessible to managers and stakeholders.

The following objective and strategy support goal one. The Reserve Manager and Education Coordinator have primary responsibility for this objective and strategy, working together with the Site Managers, and State and county construction staff.

#### **GOAL 1. Strengthen the protection and management of the Reserve to advance estuarine conservation, research, education, and coastal training.**

##### **Objective 1.3. The long-term integrity and diversity of Reserve habitats will be maintained and enhanced through stewardship, restoration, and land acquisition/protection.**

Strategy: Serve as a leader in using environmentally-friendly planning, construction, and landscaping including Low-Impact Development, Environmental Design, use of

sustainable materials, and other green techniques.

**Objective 1.4. The utility of the Reserve for conducting research, education, and coastal training programs will be enhanced and maintained through stewardship, restoration, land acquisition/protection, and construction.**

Strategy: Maintain and build appropriate facilities, infrastructure, and interpretive displays.

- Acquire appropriate suitable property and prepare plans to develop Research/Education/Cultural Visitor Center, research station, and associated out-buildings at Monie Bay.
- Maintain and augment nature trails and boardwalks at Otter Point Creek and Jug Bay.
- Design and build nature trails and boardwalks at Monie Bay.
- Provide interpretive information (including signs and exhibits) on relationships between human activities and estuarine ecosystems focusing on climate change and population growth/development patterns.

### **11.5 Existing Facilities at CBNERR-MD**

Major facilities at the components are:

- Otter Point Creek
  - Anita C. Leight Estuary Center in Harford County's Leight Park
- Jug Bay
  - Visitor Center and headquarters building in Patuxent River Park in Prince George's County operated by Maryland-National Capital Park and Planning Commission
  - McCann Wetlands Study Center in Anne Arundel County's Jug Bay Wetlands Sanctuary
  - Plummer House (office and meeting space) in Anne Arundel County's Jug Bay Wetlands Sanctuary

See Appendix I for a detailed table of existing facilities located at or adjacent to the Reserve components.

### **11.6 Key Partners**

Within the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD or the Reserve), there are five entities that have a capability to undertake construction projects, obtain permits and approvals, and manage construction contractors:

- Maryland Department of Natural Resources (multiple divisions and programs)
- Anne Arundel County Department of Recreation and Parks
- Harford County Parks and Recreation Department
- Maryland-National Capital Park and Planning Commission Department of Parks and Recreation
- Izaak Walton League of America, Harford County Chapter

Each of these entities acts independently to address construction needs on properties that they manage. In addition, they may act in partnership with one another and/or in partnership with NOAA to meet the interests of the Reserve. This chapter addresses only their Reserve-related construction activities.

**11.7 Future Directions**

**11.7.1 Future Directions: Facilities**

One of the highest priorities for the Reserve is to provide an access point, Research/Education/Cultural Visitor Center, and staging ground for education, research and coastal training activities at Monie Bay, where there are currently no facilities. Other priorities include augmenting and improving facilities at the Otter Point Creek and Jug Bay components. Table 12 lists guiding principles used in facility construction.

<b>Table 12. CBNERR-MD Guiding Principles for Construction and Site Improvements</b>
Improvements and facilities will be sited and designed to avoid negative impact core areas and to minimize degradation to the integrity and viability of the natural resources in the Reserve.
Maintain and improve existing facilities to maximize their potential to serve Reserve needs.
Support research activities related to the Reserve and the Chesapeake Bay estuary.
Support education focused on Reserve goals and objectives.
Support and control public access to meet Reserve goals and objectives.

The priorities listed above will be used by Reserve participants in several ways:

- To assess potential construction projects individually and collectively.
- To enhance consistency in decision-making.
- To help justify requests for federal funding.

The facilities construction plan below (Table 13) presents projects that are likely to need NOAA review or funding during the next five years. It will be updated as necessary to reflect the changing needs of the Reserve. All of these funds will be sought, but if funding is limited, Monie Bay will facility projects will have the highest priority over the next five years.

**Table 13. CBNERR-MD Facility Construction Plan**

Site	Description	Time	NERRS Construction Funds Sought in Thousands (2008 dollars)
Otter Point Creek	Natural study area: build new section of boardwalk.	2009-2010	\$125
Otter Point Creek	Design and build boardwalk along waters edge from Pier Property to canoe launch.	2009-2010	\$50
Otter Point Creek	Design and build storage building near the water for canoes (to protect from theft and vandalism).	2011-2012	\$60
Otter Point Creek	Design and build pavilion and composting toilet facility at the Pier Property.	2011-2012	\$120
PRP	Floating dock improvement. (PRP's #1 priority)	2009-2010	\$30
PRP	Construct new section of boardwalk and improvement to observation tower in natural study area. (PRP's #2 priority)	2009-2010	\$30
JBWS	Plummer House Renovation - Upgrade existing farm house to provide office space for site management & NERRS, visitor contact station.	2005-2008	\$85
JBWS	Plummer House Renovation – Include environmental design features in building and landscaping.	2008	\$25
JBWS	Build outdoor restrooms at Glendening Nature Preserve section of JBWS.	2010	\$75
JBWS	Design and construct a low marsh observation platform and marsh boardwalk in wetland at Glendening Nature Preserve section of JBWS.	2009-2010	\$75
JBWS	Design and construct observation platform on the bluff overlooking Jug Bay, off Pindell Bluff Trail.	2009-2010	\$65
JBWS	Build outdoor restrooms and picnic area at Sweet Flag Picnic Area at River Farm section of JBWS; upgrade septic system as needed.	2009-2010	\$120
JBWS	Cooperative Research & Education Building (In cooperation with one or more nearby universities, create on-site capacity for university students to work and to reside during their work at Jug Bay.)	2012-2014 (ten-year plan)	\$300
<b>Monie Bay*</b>	<b>Build staging ground/pavilion. HIGH PRIORITY</b>	<b>2009-2010</b>	<b>\$90</b>
<b>Monie Bay*</b>	<b>Access improvements for research such as boat ramp, pier, road/parking, gate (dependent upon land acquisition) HIGH PRIORITY</b>	<b>2009-2012</b>	<b>\$100</b>
<b>Monie Bay*</b>	<b>Build LEED-certified Research/Education/Cultural Visitor Center and associated out-buildings and permeable parking lot; renovate Research Field Station at separate location. HIGH PRIORITY</b>	<b>2009-2012</b>	<b>\$1,900</b>

All	Exhibits and signage.	2008-2012	\$250
All	Integrated communications and conferencing. Install a system to support research & education projects on-site and among Reserve sites. (Low priority project at this time)	2013-2014 (ten-year plan)	\$100

**\* Monie Bay projects have highest priority for the next five years, due to complete absence of facilities at this component, and the pressing need for a facility in this underserved county, as documented in the Monie Bay socio-cultural needs assessment (*Linking Estuarine Ecology and Community Heritage: A Socio-Cultural Needs Assessment of the Monie Bay Component*, Power 2005).**

### 11.7.2 Future Directions: Equipment

Vessels and vehicles are needed to conduct education and research programs. DNR provides pool vehicles for travel based out of the Tawes Building in Annapolis. Partners at the Otter Point Creek and Jug Bay components are able to provide vessels. At the Monie Bay component, the Deal Island Wildlife Management Area staff can sometimes provide a vessel and staff person. However, a CBNERR-MD vessel will be needed to implement research and education programs at that site. In addition, canoes and kayaks will be needed at that site once a staging ground is acquired for education and volunteer monitoring activities. A partial list of large equipment needed from 2008-2012 is listed in Table 14.

<b>Table 14. Equipment Purchase Plan</b>			
<b>Site</b>	<b>Description</b>	<b>Time</b>	<b>NERRS Equipment Funds Sought in Thousands (2008 dollars)</b>
Monie Bay	Boat, trailer, and motor.	2009-2010	\$57
Monie Bay	Canoe and kayak fleet and trailer.	2009-2011	\$22